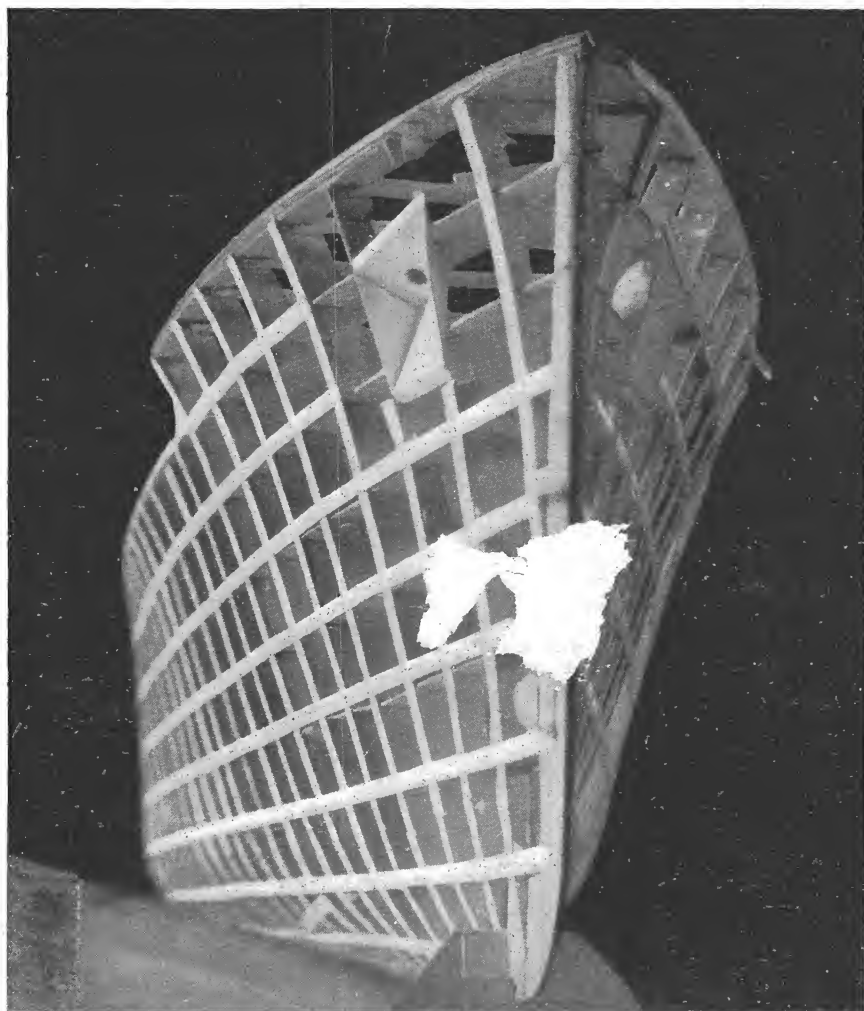


LASSIE CRAWK L.A.S.C.

# THE MODEL ENGINEER

Vol. 94 No. 2336 THURSDAY FEBRUARY 14 1946 6d



*Mr. J. Gurteen, of Luton, is building a very remarkable boat model. The only materials used are paper and card. This striking photograph shows the preliminary framework; more information and pictures of it will be found in this issue*

## Electradix Bargains!

**DYNAMOS.** D.C. Charging Dynamos, car-type, circular body, all about 1,000/1,500 r.p.m., 6 volts, 10 amps., £4. 12 volts, 10 amps.; 12 volts, 15 amps., £5. 24 volts, 40 amps., C.A.V., £10. 30 volts, 5 amps., £7 10s. 32 volts, 6/8 amps., £8 10s. 80 volts, 12 amps., C.A.V., £10.

**MOTORS.** Small Universal A.C./D.C. Motors, 1/27th h.p., 230 volts, 4,000 r.p.m., new, 55s. 24 volts, D.C. Miniature Motors, 6,000 r.p.m., totally-enclosed, 35s., with fan-blower attached, 45s.

**FIELD REGULATORS.** We have a stock for immediate delivery of useful field Regulators, F.O.B.-type. Send us your enquiries.

**SOLENOIDS.** 24 volts, D.C., heavy solenoid, lift 14lb., 15s.; small 12-volt type, pull 1 oz., 1 inch, 6s. 6d.

**ROTACEPTORS.** Pre-war type for E.H.T. at 50 cycles from 12 volts D.C., two sizes, 5,000 volts and 10,000 volts at 20 m.a., for portable neon luminous tubes or daylight colour-matching lamps. Completely iron-clad with small interruptor motor at top, transformers and condensers below. Overall size, 6 in. by 4½ in. by 13½ inch high, £6 10s. each.

**MOTOR BLOWERS.** In addition to mains A.C./D.C. Blowers we have some for low-voltage D.C., 32-volts, ½ h.p., with output of 500 cu. ft. per minute, £8 10s.; also some small valve-cooling or Lab. Blowers, work off 12 volts, £5 10s. We have other Blowers in stock up to 6 h.p.

**FANS.** Table model Fans, A.C., 220/230 volts, with 10-in. blade and guard, 45s. G.E.C. 210 volts D.C., 25s.

**MAGNETS.** The wonder midget Magnet, alni perm. steel disc, weight only ½ oz., ½ in. dia., ¾ in. thick with ¼-in. centre hole, 3s. 6d. each. Large selection of horseshoe Magnets in stock. Send for leaflet "M.E."

**BELLS.** Outdoor Ironclad, Tangent, for works or schools, 230 volts A.C., 42s. Indoor House Bells, 5s. 9d. Bell Transformer, 3-5-8 volts, 7s. 6d.

## Electradix Radios

214, QUEENSTOWN ROAD, LONDON, S.W.8.

Telephone: MACAULAY 2159

## PROGRESS

*On sale Christmas 1945*

Induction Coils—4 and 6 Volt Transformers—4/6 Volt Electric Bells—Bell Pushes and Switches—Battery Testers—Plastic and Metal Bulb Holders—and our well-known Model Practice Keys and Buzzers

*Coming in 1946*

(in the order in which we anticipate they will be ready)

Pocket Compasses—Plastic Stamp Magnifiers—4 Volt Electric Motors—Plastic Telescopes—Microscopes—Model Steam Engines—Electrical Outfits—Model Dynamos—6 and 20 volt Electric Motors—20/3½ Volt Transformers—Model Sewing Machines

Please book your orders as early as possible

## SIGNALLING EQUIPMENT LTD.

Merit House, Southgate Road, Potters Bar, Middlesex

Phone: Potters Bar 3133/4. Cables and Grams: SEL, Potters Bar

## You'll Be Glad

YOU KEPT ON SAVING

*When You Can*

*Again Buy An*

# ADANA

ADANA PRINTING MACHINES  
TWICKENHAM, MIDDLESEX

*The Leading Monthly Journal for  
Constructors is*

## " MODEL RAILWAY NEWS "

::

::

DEVOTED TO THE PLANNING AND  
CONSTRUCTION OF MODEL RAILWAYS,  
INCLUDING ENGINES, ROLLING STOCK  
AND ALL ACCESSORIES FOR STEAM,  
ELECTRIC AND CLOCKWORK SYSTEMS.

*Published Monthly. Price 9d. Annual Sub-  
scription 10s. 6d.*

*Copies are normally obtainable through your  
newsagent, but owing to paper rationing most  
suppliers now have a waiting list of subscribers.  
In case of difficulty write to the publishers:*

::

::

PERCIVAL MARSHALL & CO.  
LTD.

22, GREAT QUEEN ST.,  
LONDON, W.C.2.

And at Maidenhead, Berks.

**The Finest ENGINEERS' TOOLS  
and LARGEST STOCK IN LONDON**

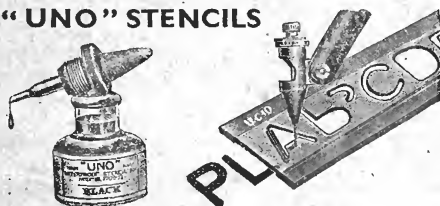
obtainable from **BUCK & RYAN Ltd.**

**LATHES THE "TOOL PEOPLE,"**  
MICROMETERS 310-312, Euston Road, N.W.1  
CALIPERS . GAUGES and at  
SQUARES, TAPS & DIES 261, Edgware Rd., W.2  
MILLING CUTTERS LONDON

**"UNO" PEN STENCILS IN STOCK**

Send for "Uno" list. Price (with post) 3d.  
No Tool List available. Quotations sent on request.  
Enquiries by Phone: EUSTON 4661.

**"UNO" STENCILS**



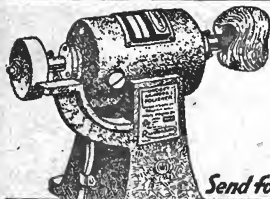
**"UNO" WATERPROOF INK**

FOR LETTERING PLANS & TRACINGS

Send for illustrated catalogue.

**A. WEST & PARTNERS, LTD.,**  
36, Broadway, Westminster, London, S.W.1

**MIDGET GRINDER  
AND POLISHER**



**Inexpensive  
& unequalled  
for Drills,  
Small Tools  
and  
light duties**

Send for Leaflet K 310

**RUNBAKEN-MANCHESTER**

**MIDLAND INSTRUMENT CO.**

Comprehensive range of Lucas instrument wires, Eureka and nickel-chrome wires, flexes and cables, sleeving, Empire Cape rubber, Grommets, L.T. rectifiers, Avometers, Wee Meggers, speakers, chassis, counters, synchronous motors, microphones, electrical accessories, etc.

New February List 1d. S.A.E.

**18, HARBORNE PARK ROAD**  
BIRMINGHAM 17 Phones: HAR. 1308 & 2664

**LET ME BE  
YOUR FATHER**

You need help and Fatherly advice in difficult times like these. I am in the position to give that to you free.



We teach nearly all Trades and Professions by Post in all parts of the World. The most progressive and most successful correspondence College in the World.

If you know what you want to study, write for prospectus. If you are undecided write for my Fatherly advice, it is Free. Distance makes no difference.

**Do any of these subjects interest you ?**

Accountancy Examinations	Mining. All Subjects
Advertising and Sales Management	Mining. Electrical Engineering
Agriculture	Motor Engineering
A.M.I. Fire E. Examinations	Motor Trade
Applied Mechanics	Municipal and County Engineers
Army Certificates	Naval Architecture
Auctioneers and Estate Agents	Novel Writing
Aviation Engineering	Pattern Making
Aviation Wireless	Play Writing
Banking	Police, Special Course
Blue Prints	Preceptors, College of
Boilers	Press Tool Work
Book-keeping, Accountancy, and Modern Business Methods	Production Engineering
B.Sc.(Eng.)	Pumps and Pumping Machinery
Builders' Quantities	Radio Communication
Building, Architecture and Clerk of Works	Radio Service Engineering
Cambridge Senior School Certificate	R.A.F. Special Courses
Civil Engineering	Road Making and Maintenance
Civil Service	Salesmanship, I.S.M.A.
All Commercial Subjects	Sanitation
Commercial Art	School Attendance Officer
Common Prelim. E.J.E.B.	Secretarial Examinations
Concrete and Structural Engineering	Sheet Metal Work
Draughtsmanship. All branches	Shipbuilding
Engineering.	Shorthand (Pitman's)
All branches, Subjects and Examinations	Short Story Writing
General Education	Speaking in Public
G.P.O. Eng. Dept.	Structural Engineering
Heating and Ventilating	Surveying
Industrial Chemistry	Teachers of Handicrafts
Institute of Housing Insurance	Telephony and Telegraphy
Journalism	Television
Languages	Transport Inst. Examinations
Mathematics	Viewers, Gaugers, Inspectors
Matriculation	Weights and Measures Inspectors
Metallurgy	Welding
	Wireless Telegraphy and Telephony
	Works Managers

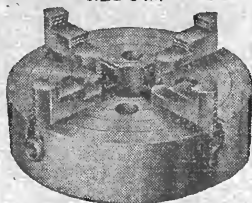
If you do not see your own requirements above, write to us on any subject. Full particulars free.

Direct Mail to—

**Dept. 17,  
THE BENNETT COLLEGE,  
SHEFFIELD.**

## LIGHT PATTERN INDEPENDENT 4 REVERSIBLE JAWS

SIZE 6-in.



This Chuck is a much lighter pattern and has less overhang than the ordinary 4-jaw chucks on the market, and so can be used on lathes as small as 3½-in. centres without overloading their small mandrels, thus work can be chucked up to the full capacity of the lathe, while owing to the narrow-edged jaws, rods as small as ⅛-in. diameter or less can be held.

### SPECIFICATION

**BODY** is of semi-steel recessed at the back between the jaw grooves for lightness.

**THRUST** of the screws is taken in both directions by hardened thrust blocks; these are inserted from back of Chuck and can be easily removed when required.

Model No. 34

Diameter of Body ...	6 in.
Diameter of hole through Body ...	1½ "
Projection of jaws from face of Body ...	1½ "
Width of Body ...	1½ "
Diameter of Backplate recess ...	3½ "
Maximum diameter Chuck will hold ...	7 "
Approximate weight ...	9 lb.
<b>PRICE—6-in. Chuck</b> ...	<b>77/6</b>

Per C.O.D. from :—

**GARNER'S SHEFFIELD ROAD, BARNLEY.**

'Phone : 2866.

## DRAWING INSTRUMENT *Specialities*

Now only available for work of National importance.

We look forward to the time when we shall be able to meet the requirements of all our friends.

In the meantime, orders will, wherever possible, be dealt with in rotation.

**A. G. THORNTON LTD**

*Drawing Instrument Specialists*  
41 GARTSIDE ST. MANCHESTER 1

T22

## "ENGINEERING

## OPPORTUNITIES"

### IMPORTANT GUIDE

This unique handbook, "Engineering Opportunities," shows the easy way to secure A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.M.Brit.I.R.E., City & Guilds, A.M.I.A.E., etc.

We guarantee—

**"NO PASS—NO FEE"**

Details are given of over 150 Diploma Courses in all branches of Civil, Mechanical, Electrical, Automobile, Aeronautical, Radio, Television and Production Engineering, Draughtsmanship, Tracing, Inspection, Building, Government Employment, R.A.F. Maths, MATRIC, etc

A copy of this enlightening guide to well-paid posts will be sent on request—**FREE** and without obligation.

### BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

13, Shakespeare House,  
17, Stratford Place, LONDON, W.1

## MODEL AIRCRAFT

(The official journal of the S.M.A.E.)

Subscription : 13/6 per annum, post free.

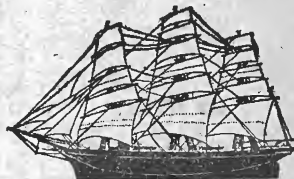
**PERCIVAL MARSHALL & CO. LTD.**

23, Gt. Queen St., London, W.C.2  
and at Maidenhead, Berks.

### PLANS

8 sheets (each  
35" × 22") and  
instructions

**9/6d** (postfree)



### The Famous "CUTTY SARK"

The plans for this best remembered of all the clippers have been prepared by Arthur W. Kirtton, Secretary of the Bristol Ship Model Club. Each sheet covers a definite stage in construction.

\* The 1946 list of over 250 plans and planbooks for all kinds of models is now on sale. 3d and an unstamped addressed envelope brings your copy. Write to:

**MODEL CRAFT Ltd.** 77 (ME) Grosvenor Rd., LONDON. S.W.1

# THE MODEL ENGINEER

Vol. 94 No. 2336

Percival Marshall & Co., Limited  
Cordwallis Works, Maidenhead

February 14th, 1946

## Smoke Rings

### Making a Start

A NEWCOMER to the hobby of model engineering writes me that he is full of troubles. He first became acquainted with THE MODEL ENGINEER in the corporals' mess of an R.A.F. station. He sometimes missed seeing the weekly issue, as he says that if he arrived late for his cup of tea, it had mysteriously disappeared. But as the result of browsing over the copies on which he could lay his hands, he says that he has an "unquenchable thirst for more information on this interesting subject." He has already gone so far as to acquire a second-hand motor-driven Myford lathe, but here he has stuck. He says he can't buy a copy of THE MODEL ENGINEER anywhere, except by the merest chance, there are no books on model making to be had, and though he feels he ought to join a Society, he does not know where to apply in his neighbourhood. What is he to do to get going? He tells me he has never done any model making, and I rather imagine from his letter that he has had no real mechanical training of any kind. To take his troubles in the order stated, the supply position of THE MODEL ENGINEER is now a little easier than for some time past, and, if he will place a regular order, his newsagent should be able to get an extra weekly copy for him. Model-making books are scarce at the moment, but we have a number of new titles and reprints in hand which will be available very shortly. Back issues of THE MODEL ENGINEER are frequently advertised in our "Sales and Wants" columns, and if my correspondent could purchase a volume or two in this way he would have a mine of information to study, and drawings and instructions for making a number of interesting and useful workshop articles. He does not tell me that he has any special desire to make a locomotive, or a traction engine, or a power boat, and until some particular fancy makes itself felt, the best thing he can do is to get his workshop fitted up, and a modest kit of tools together. If he will try his hand at making some of his equipment, including, perhaps, a small drilling machine, he will acquire much useful knowledge of materials and a gradually improving degree of handicraft skill. In addition to this, however, he should certainly join a local Society, and I have given him two addresses within easy reach. There he will find not only sympathetic and helpful friendship, but opportunities of inspecting models and asking questions about them, and, perhaps, facilities for borrowing books or drawings to help him with his work. In fact,

this Society membership will do more than anything else to enable him to get his own workshop going in an economical and efficient way. He can get information on the spot at every meeting, and inspiration as to what he should or should not try to make. The interest of model engineering grows upon the novice by degrees. As his skill in using tools develops, so his ambitions in his building programme will take more and more definite shape and his achievements become more satisfying. My correspondent has got his lathe. Round that lathe he will build a workshop, and in that workshop his dreams of locomotives, or petrol motors, or aeroplanes will surely become true. The day will come when he in turn will be giving a helping hand to another novice who will be wondering how to make a start. I wish him happy progress on his journey.

### Exhibition at Andover

I HEAR that the Andover Society will hold its first exhibition on Easter Saturday and Monday, at the Guildhall, Andover. The show will open at 2.30 p.m. on the Saturday, and an excellent display of work is promised. The Hon. Secretary is Mr. W. H. Crothall, 53, Charlton Road, Andover.

### Regular Visitors

A SCOTTISH correspondent writes me that he and his wife are already making plans for a visit to THE MODEL ENGINEER Exhibition next August. This will, he says, be their fifteenth consecutive annual visit to our Exhibition. Is this a family record? On this occasion a fine model locomotive will be included in the party.

### The Congreve Clock

A N urgent appeal for fuller information about the Congreve clock, made by Mr. J. W. Stephens, reaches me from Mr. D. L. Scott, of Dunedin, N.Z. The articles now being so kindly supplied by Dr. J. Bradbury Winter will answer this request, but I am sure that both Dr. Winter and Mr. Stephens will be gratified to know that a keen interest in their work has been aroused so far afield. Mr. Scott is a member of the Dunedin Society and one of New Zealand's most skilful model makers.

*Percival Marshall*



# A Paper Boat

By JOHN GURTEEN

*[Among the many fine exhibits to be seen at the recent model engineering exhibition at Luton was one which attracted our special attention. It was a miniature reproduction, as yet only partly completed, of the hull of a liner, and the only materials used were card and paper. We were fortunate enough to meet the builder, Mr. John Gurteen, with whom we had a most interesting chat. He has now submitted some photographs and a description of his hull, and we are pleased to publish them herewith. A model such as this may not be strictly model engineering; but, in view of the fact that every detail of this unusual piece of work, internal as well as external, is as near to scale as it can be, we feel more than justified in allotting space to it. We have seen many admirable models made of card and paper, but none that involves more skill, patience and perseverance.—Ed., "M.E."]*

**A**BOUT nine years ago, some friends and I were discussing the building of boats (model and otherwise), and I, rather rashly, stated that I should like to make a model in paper or light card. My friends were very sceptical about the idea and thought it would be impossible to produce a hull of sufficient strength with such material. However, the idea grew on me and I decided to try it out.

I set to work on the drawings of a pretty-looking vessel of ambitious dimensions and soon produced the necessary lines for the hull. The scheme was to build the ship "inside and out" so that I could learn something from the job and so that it could be used for demonstration purposes.

Construction was started on a 6-in. length of keel at the bows, and ribs cut to shape in card were glued in place. These were found to be too flimsy, and a second start had to be made. This time the ribs were made of two or three layers of card and had more strength.

At this time, I visited my stationer's and bought a gross of packets of plain postcards and one or two bottles of gum from Woolworth's. With

these materials the hull gradually took shape until finally, it was complete in skeleton form. It was a fascinating experience to find the hull lines slowly appearing during the building of the job.

Plating was the next operation, and here, I believe, I committed a serious blunder. I plated from the keel upwards, and the resulting contraction of the cardboard plates became painfully obvious as the ship gradually increased in beam. Measures were taken to correct most of the errors thus introduced, but the occurrence completely upset my length-to-beam ratio. I decided now on a drastic remedy, and this consisted of cutting the hull in the middle and inserting a parallel portion between the two halves. This would have the effect of increasing the length and thus restore the lost ratio, but the scale would have to suffer a little. To a large extent this could be cured later. With the aid of cardboard formers the new section was made and was an extremely rigid job. I then cut the hull with a hacksaw. Contrary to expectations the pieces did not spring out of shape, but took it quietly and remained "static" so well



*A three-quarter view from the bows of the model paper liner*

that no straining was necessary in fitting the new section. The result was satisfactory, but the alterations meant more modifications on the drawing board.

Meanwhile, I had been unable to resist the temptation to put in some of the decks and cabins at the forward end; experience now told me that these were too flimsy. There was now a wholesale scrapping and a rather long time spent in finding methods to prevent floors warping. The secret was eventually found to be that the sections should be kept as small as possible in area.

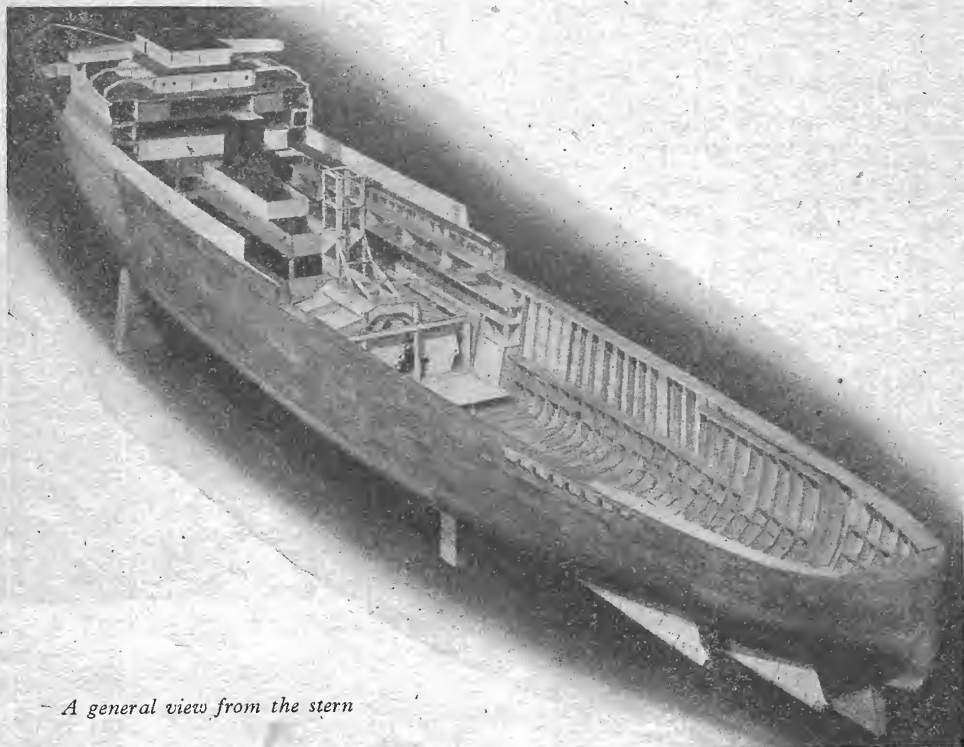
Details of the *Queen Mary* were to hand, and work was commenced on the boiler-rooms. I then discovered what a lot I did not know about a steamer's works. As this job had been

preserve the shadow detail and, at the same time, to render the necessarily very delicate gradations at the highlight end of the scale. Detail in white card is very nice to examine visually, but suffers severe "flattening" when reproduced on a photographic plate.

(1). A three-quarter view from the bows. The length of the model is 52 in.; beam, 7 in., and the scale is 12 ft. to 1 in. All windows in superstructure are glazed with cellophane.

(2). General view from the stern.

(3). View looking down on dining saloon (3rd class), and the boiler rooms. The framework around the uptakes is necessary to carry the decks above and around this region in such a way that they may be easily withdrawn. No. 1 boiler room (auxiliary boilers) is situated two



*A general view from the stern*

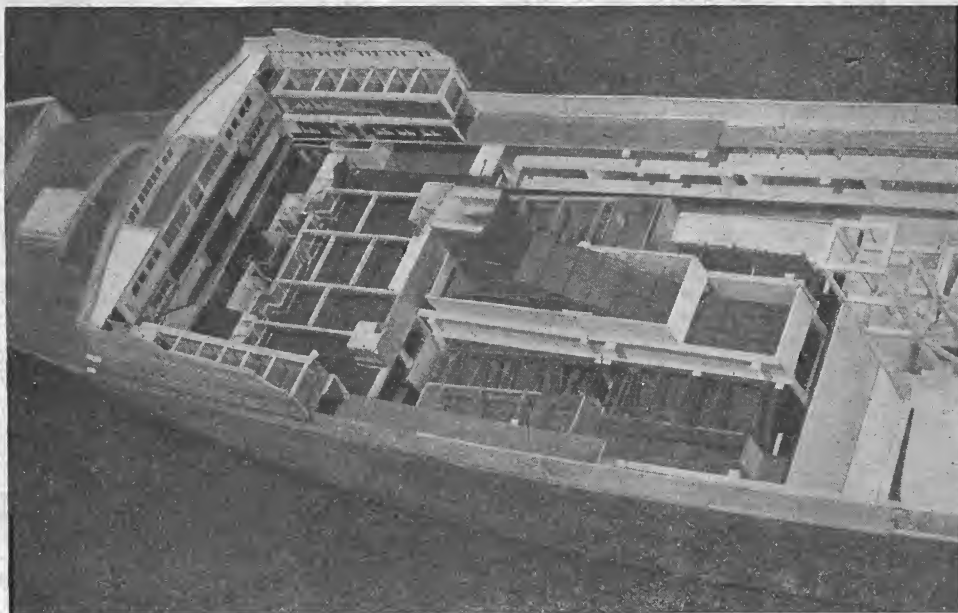
done entirely for amusement and having very little time at my disposal, my ship grew very slowly. Long nights of home "firewatch" duties, however, gave me plenty of chances, and during these periods considerable progress was made. There had been several occasions when the construction was stopped for long stretches; one of these was a full eighteen months.

I will not go into much constructional detail here, but will reserve that for some future occasion. I propose, therefore, now to describe the photographs.

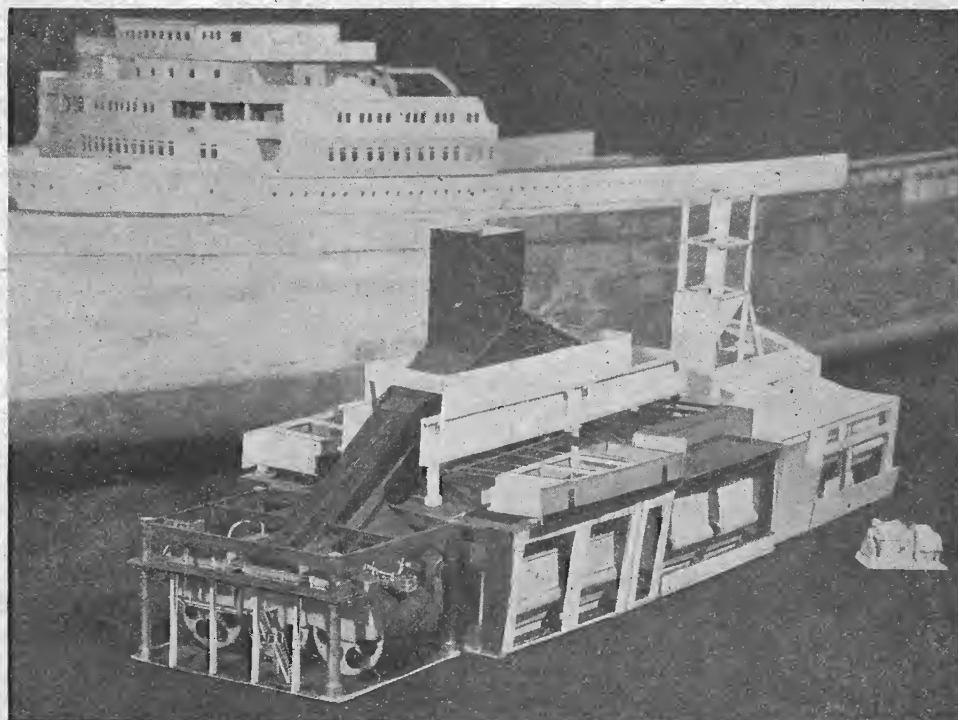
The subject is a difficult one for the camera. My resources were strained in the attempt to

decks below the dining saloon, and its uptakes merge into the main trunking from boiler rooms 2 and 3. Between boiler rooms 3 and 4, is the forward turbo-generator room. Boiler room 4 is served by the, as yet, unfinished trunking to the right of the picture.

(4). This picture shows the assembly of the boiler rooms outside the hull with a turbo-generator alongside. Eight of these latter will have to be made. No. 1 boiler room can be seen in the foreground, with its three double-ended Scotch boilers. The whole of the boiler and engine room layout is modelled very freely on that of the *Queen Mary* except that in the latter case there is an additional boiler room.



*Looking down on dining saloon and the boiler rooms*



*The assembly of the boiler rooms outside the hull with a turbo-generator alongside*

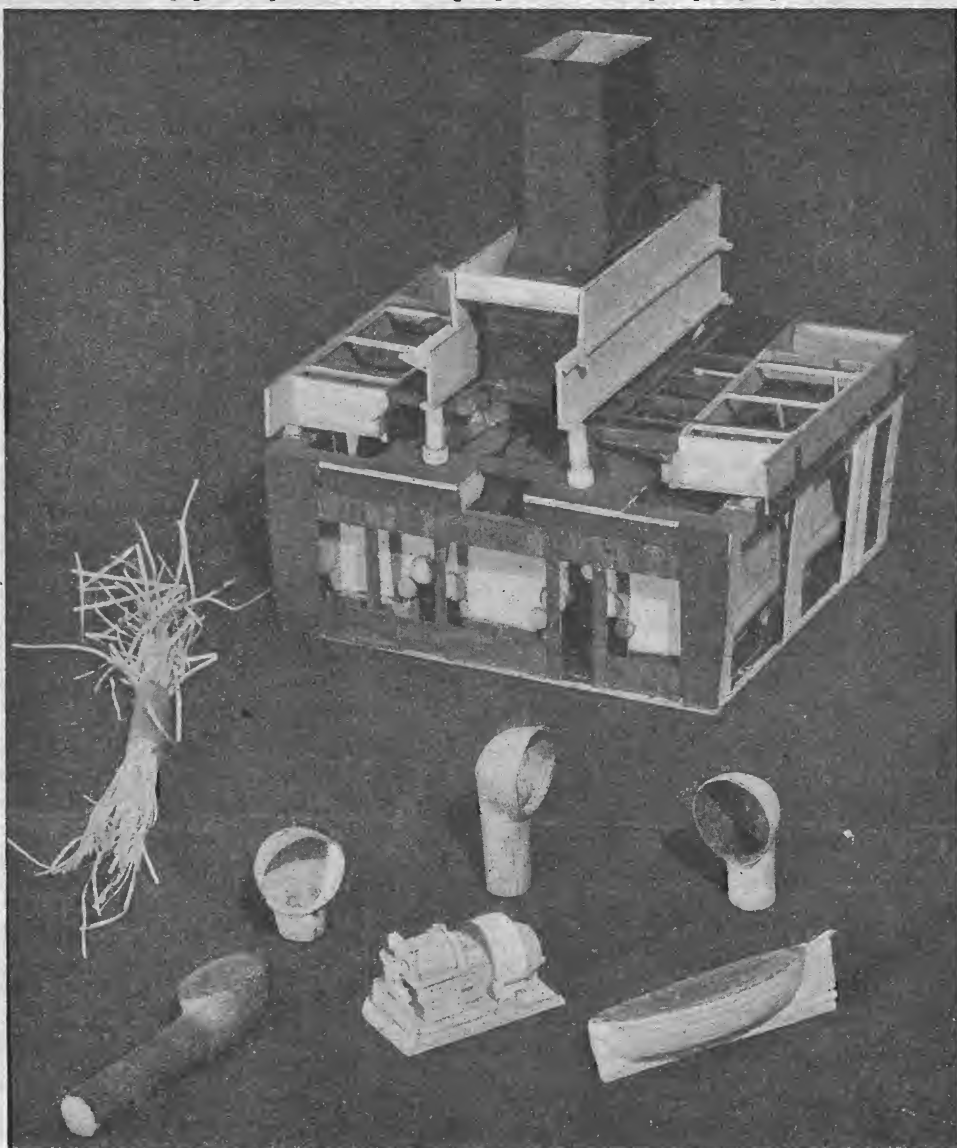


The Yarrow boilers of rooms 2, 3 and 4 are to be seen in position. Each room contains six boilers.

(5). *Bits and pieces.*—Included are No. 2 boiler room, three of the large ventilators, a turbo-generator and a life-boat (under construction). Also to be seen are the wooden former and a bundle of paper strips used in making

the end of the Luton exhibition, some ungenerous and light-fingered person stole it from the parent ship, and it must now be written off as a total loss.

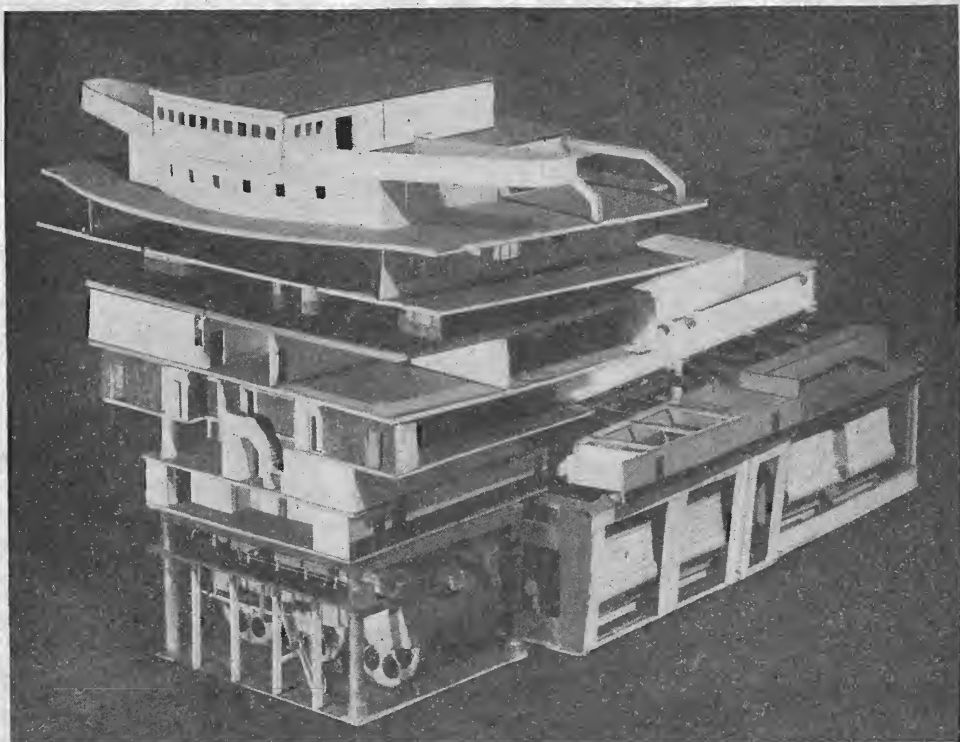
(6). At this stage, the picture shows a rather optimistic conception of things to come. I call it playing "dolls' houses," and the game should prove interesting in piling up the sub-assemblies



*Some bits and pieces of the model paper liner*

the ventilators. No attempt has been made to get the proper finish on the ventilators, as I am not ready yet for them. All I have done is to satisfy myself that I have evolved a method for their manufacture. I regret that I am unable to illustrate the completed life-boat, as towards

and demonstrating the layout and relation of parts from an unusual but to my mind, an ideal angle. Whether I shall have time for all this is another matter, but still it is an idea which can be applied to far less ambitious projects.



*An optimistic conception of things to come*

## Soft Jaws

I HAVE to thank a contributor for his article on soft jaws for a three-jaw chuck. I made a set of these jaws and, in use, they are well worth the making, because they provide a three-jaw chuck that is really self-centring. Being soft, they naturally wear out of truth slightly; theoretically, they should not, but in practice they do, and this is the reason for my writing these notes.

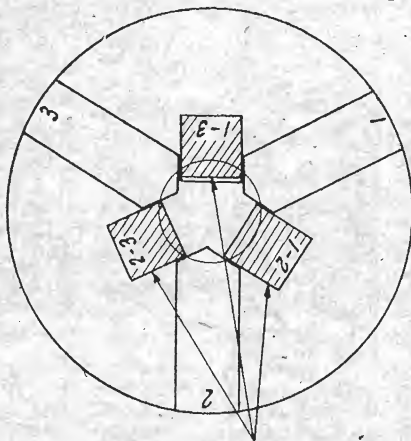
When I made my soft jaws, they required boring out after fitting over the hardened jaws, and this operation was carried out by closing the jaws on a round disc,  $\frac{1}{8}$  in. wide and a little smaller in diameter than the face of the chuck. This disc was gripped by the back or tail ends of the jaws to allow boring up to the disc; it was anything but

true, owing to unequal pressure between scroll and jaws, so I had a brainwave, as so many modellers do.

I have now a perfectly true chuck; the sketch

will explain. Furthermore, the soft jaws can be bored *right through*, and the three steel blocks can be used on a subsequent rebore of the soft jaws, if they are numbered to go between their respective hardened jaws. I do not claim originality for this idea, but I have never seen it applied before.

The steel blocks must be all the same width, to give equal scroll pressure on the jaws. I filed mine and tested each one separately until each was the same tightness when clamped by tightening the chuck.—B. E. SIMPSON.



SIZE OF STEEL BLOCKS  
TO SUIT CHUCK.

# "Hielan' Lassie"

By "L.B.S.C."

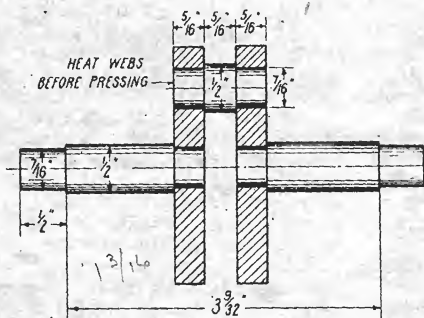
A 3½-in. Gauge L.N.E.R. 4-6-2

SOME folk look on the making of a crank-axle as a fearsome job, and judging by the way the process has sometimes been described by various folk, I don't wonder at a raw beginner being scared stiff! Well, you just take it from Curly that there is nothing to worry about. My first crank-axle, made somewhere around 1890, consisted of two brass webs cut laboriously from an old brass lock-plate, with hand-drilled holes through which were driven two French nails, by aid of the domestic coal hammer; and they held tighter than any job done by aid of elaborate gear and oodles of noughts and crosses. How do I know? Well, if you had seen the poor kid's fingers after the job was completed, you wouldn't ask *that* question. Anyway, after the superfluous bits of nail had been sawn off "outside and inside," and the whole issue cleaned up with a file (or rather a part thereof) it ran quite truly and never came loose.

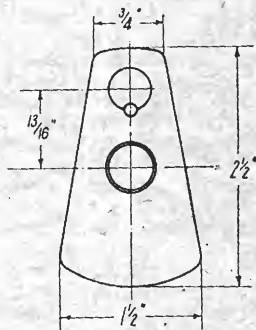
There are three ways by which you can turn out a crank-axle for "Lassie"; press-fit, brazed, or turned from solid. Please yourselves. The press-fit method is the one I adopted for the single-crank axle on my compound "Jeanie Deans," as detailed out in full in the issue for October 11th last; so a brief repetition giving the slight differences in dimensions should suffice here. Two pieces of steel 2½ in. long, 1½ in. wide, and ⅝ in. thick, are needed for the webs; mill, plane or file these taper, so that they are

one piece about 1⅜ in. long, and two more about 2¼ in. long. Turn down ⅞ in. length of the short one, until it just *won't* enter the holes in the webs; say 1/64 in. larger. Then very carefully turn down ⅓ in. until it *will* enter very tightly by hand. If your lathe has a "mike" collar on the cross-slide, bring it back half a division; to make up for any slackness in the threads, the best way is to turn it back about half a turn, then bring it forward again to within half a division of where it was before; sounds Pat-like, but is the only reliable way. Then turn the rest of the spigot with this setting of the slide-rest, and note it for the easy sizing of the other spigots. Face off the superfluous ⅓ in., put the weeniest bit of chamfer on to give the spigot a start when pressing, and serve all the rest of the spigots the same way, except that the "oversize allowance" for the wheel seats should be only quarter division, instead of half, to avoid any risk of splitting the wheel-bosses. If your cross-slide hasn't any graduated collar, you'll have to use your own judgment about how far to set back, by carefully watching the position of the wheel or handle.

Warm up one of the crank-webs, but not too hot; just so that a drop of water on it will fizzle, and press in the crank-pin, using the vice as press, with a bit of copper sheet between the rough jaws, and web and crankpin, to prevent any marking of same. Line up web No. 2 with its mate, by putting a piece of ⅞ in. round steel



Press-fit crank-axle



¾ in. wide at the narrow end, a job easily done if the bits are temporarily soldered together. Leave the ends for the time being. Mark-off the position of the two holes as shown; drill first a ⅓ in. pilot hole, then open to 27/64 in., and finally ream ⅞ in., using drilling-machine or lathe. Hand work is hardly true enough. Warm up the embryo webs until the solder melts, then part them, and wipe off all superfluous "tommy" before it has a chance to set.

The axle and crank-pin can be made from ½-in. round steel. Either silver-steel or ground mild-steel will do. Ordinary drawn steel should only be used if nothing else is available. Part-off

through the axle holes, which should fit fairly tight; then warm up No. 2 web and squeeze it home on the crankpin spigot. The two webs should now be dead in line, and the two halves of the axle can be pressed in, in similar manner, using a piece of ⅞ in. flat steel between the webs, to prevent their being closed in by the squeezing process. Warm up the webs as before. The whole bag of tricks should now be as firm as if it were cut from the solid. If you have any doubt at all, drill a couple of No. 32 holes in the position shown by the little circle in the side view of crank-axle, that is, half in web and half in crank-spigot, and drive a piece of ⅓ in. silver-

steel in each, to serve as a key; but if the spigots are turned correctly, this shouldn't be necessary. Finally, grip one end of the axle in the three-jaw, and turn the ends of the webs as shown; be careful how you feed the tool into cut, or you'll be like one of my 1917/18 munition girls:—

There was a young lady named Jewel,

Her chuck knocked the tip off the tewel;

She said "What a mutt

For not stopping the cut—

Oh, I feel just an absolute fewel!"

Incidentally, I made up an appropriate limerick for each of the thirty-seven; the office girl typed them out, and hung up the "poem" in the girls' mess-room, to their intense amusement. It was just silly things like that which broke the monotony of repetition work and helped to maintain maximum output. It pays to study human nature! The outer end of the axle can be steadied either by centring it with a centre drill, and bringing up the tailstock with a centre-point in it; or you can use the tailstock chuck, with the jaws just open far enough to form a temporary bearing for the free end of the axle. Don't forget a spot of oil in either case! Any discoloration caused by heating the web, can be removed by means of a bit of fine emery-cloth, and the axle polished up.

### How to Make a Brazed-up Axle

The webs are made as described above, except that the holes are reamed  $\frac{1}{8}$  in. instead of  $\frac{3}{16}$  in. Countersink them both sides; and with a rat-tail file, make about four shallow depressions right through each hole. This wheeze will allow the molten brass to penetrate right through the full length of each joint, instead of staying on the outside, and leaving the middle of the contact area unbrazed; brass doesn't penetrate close-fitting joints in the same way that silver-solder does. Turn up another straight axle, exactly the same as the two already made, and drive the webs on to this, so that they are a little over  $1\frac{1}{4}$  in. from the wheel-seat shoulders, and a full  $\frac{1}{8}$  in. between. The crank-pin should be about  $1\frac{1}{4}$  in. long to start with, and is merely a piece of the same kind of steel as is used for axles; it doesn't need any turning, but is simply driven through the holes in the webs, with a little bit projecting each side. Now wind up a "spring" of 16-gauge soft brass wire, or Sif-bronze wire if you can get it, to a diameter that will fit tightly on the axle and pin; cut off six of the coils, bend them so that the ends join, and the coils are perfectly flat, then put four of them outside the crank-webs, around axle and projecting part of pin. The remaining two go around the axle inside the webs, and can be sprung on. All the rings must be pressed into close contact with the webs, and well covered over with wet flux; "Boron Compo" is about the best I know for brass, and a special kind is sold for Sif-bronze. Lay the prepared axle in your brazing pan, and get busy with a blow-lamp or an air-gas blow-pipe; bring the whole bag of tricks to an even bright red, and you'll find that the rings will melt, filling up the countersinks and partly disappearing into the joints. Let the job cool to black, and then quench out in clean cold water—beginners remember that

acid pickle must not be used for steel brazing.

To finish off, carefully saw out the unwanted portion of axle between the crank-webs, and file smooth; also file off the projecting pieces of crank-pin outside the webs. Note—no rings are placed on the inner side of the webs around the crank-pin, as the molten metal might run over the surface of the pin, and a little careless work in cleaning same might spoil its circularity and cause both knocking and excessive wear on the big-end brasses. The ends of the webs are turned, as described above, and the whole issue cleaned and polished up.

Separate eccentrics, as described below, are needed for either of the above axles; but if an axle is turned from the solid, the eccentrics can be integral with it, if preferred, and they need not be quite so large in diameter.

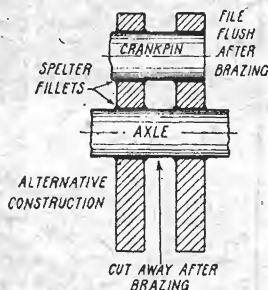
### How to Turn Crank-Axle from Solid

I wouldn't advise anybody to adopt this method unless they have a good hefty power-driven lathe; it is too much of a good thing to hack a single balanced crank out of a chunk of  $2\frac{1}{2}$ -in. steel shafting  $4\frac{1}{2}$  in. long, on a pedal-driven machine. Anybody attempting it, unless an ardent footballer, cyclist, or other person used to a considerable amount of "leg exercise," would probably wake up in the middle of the night with an acute and painful attack of cramp in both thighs. Apart from my knowledge of human physiology, I had one bad experience of this at my old home at Norbury, where I used an upstairs room for a workshop, and pedalled my lathe. For some special reason, now forgotten, I turned forty-four carriage wheels for  $2\frac{1}{2}$ -in. gauge rolling stock, in one afternoon and evening; and at 2.30 a.m. had the most agonising pains I ever had in my life, becoming violently sick, dizzy, and finally "passing out" altogether. Fortunately, my fair lady knew what to do, and got me around all right, but I was mighty careful not to overdo it again; therefore, take heed, all ye over-enthusiasts! However, an electric motor or an I.C. engine doesn't get cramp, and if your lathe is hefty enough to stand heavy cutting, you can chance it. The piece of metal, size given above, should be chucked in the three-jaw, and faced off, the true centre being marked at the same time with a centre-drill; reverse in chuck, and ditto repeat the other end. Put the "roller" on a couple of vee-blocks; and with a scribing block and try-square, mark off two lines right across each end, at right-angles, cutting through the centre holes. The location of the crank-pin and eccentric centres are then marked off on these, as shown in the illustration; and fairly deep centres made with a size E centre drill.

On the finished engine, the valve eccentric is located to the left of the crank, close up to it, and leading by a quarter of a revolution; that is at 90 degrees to the main crank-pin. The eccentric for the lubricator is exactly opposite, and approximately  $\frac{1}{2}$  in. from the crank-web; actually, its exact position doesn't matter a Continental, as it doesn't have to synchronise or specially line up with any other part of the motion. My own way of setting about the job would be to use a roughing-tool first; that is,

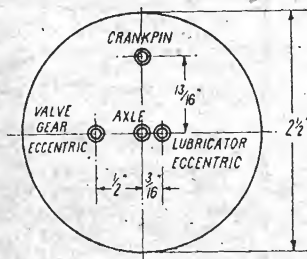


a pointed tool with a rounded tip and plenty of top rake. The chunk of metal would be mounted on its true centres, and the bulk of the metal turned away between the ends and the crank-webs, leaving the necessary blobs for the eccentrics in their proper location. A parting-tool and a knife-tool would be substituted for the roughing-tool, for such places where the latter would not reach: for instance, sharp corners. A full-sized disc would also be left at each end, with the centre-holes in it. The piece would next be mounted on the valve-gear eccentric centres, and that component turned out. As long as the true centre and eccentric centre are  $\frac{1}{2}$  in. apart, the actual diameter of the eccentric itself doesn't matter; so you can reduce its diameter until the narrower side of it comes



*Braised crank-axle*

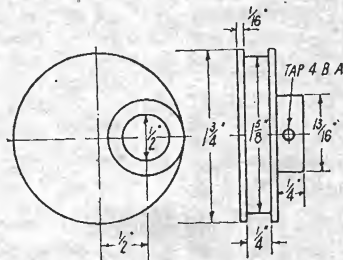
level with the finished diameter of the axle. The eccentric for the lubricator need only be 1 in. diameter; and this is, of course, turned with the lathe centres in the centre-drill holes  $\frac{3}{16}$  in. from true centre. After that, mount the piece on the crank-pin centres, and turn the pin to size; you'll have to watch your step here. An outside in parting-tools is about the best gadget for that job—but remember the limerick! Finally, mount the shaft on the true centres again, turn off the discs, finish-turn the axle to size, and turn the wheel seats, so that the length over shoulders is  $3 \frac{9}{32}$  in. The excess at the ends of the wheel-seats can be faced off with one



*Centres for turning crank-axle from solid*

end of the axle held in the three-jaw, and the outer end running in a steady. An improvised steady can be made in a very few minutes; fix two bits of wood at right-angles by nails or screws, and with one angle resting on the lathe bed, and the other vertical, run the latter against a  $\frac{1}{2}$ -in. drill in the three-jaw, by means of the tailstock minus its centre. The drill will make

a hole in the vertical piece at exact centre-height, then all you have to do is to put it over the end of the crank-axle, clamp the horizontal part to the lathe bed by means of a coach-bolt and a bit of plate, and cut the crank-axle back to length without any fear of it coming adrift or running out of truth. The crank-webs will be

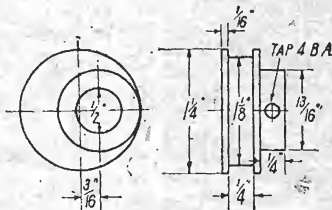


*Eccentric for valve-gear*

circular, and may be left so, if you aren't related to Inspector Meticulous; but those who wish, can easily alter them to the shape shown, by milling, planing, or sawing and filing away the superfluous metal.

### Eccentrics

The built-up axle requires two eccentrics, for valve-gear and lubricator drives, and the sizes are given on the accompanying illustrations. The turning job is quite simple; chuck a piece of steel bar of requisite size in the three-jaw, face the end, turn the groove with a parting-tool, using slow speed and plenty of cutting oil, and part off at a good  $\frac{1}{8}$  in. from the end. Mark a centre-pop  $\frac{1}{2}$  in. from true centre on the big one, and  $\frac{3}{16}$  in. from centre on the smaller one;



*Eccentric for lubricator drive*

the true centres are indicated plainly by the tool marks after facing. Chuck the eccentric in four-jaw with the pop-mark running truly; then use first a centre-drill, then a  $\frac{1}{8}$ -in. pilot-drill, next a  $31/64$  in., and finally a  $\frac{1}{2}$ -in. parallel reamer. This is about the only way the average amateur can get a true hole through an eccentric, so that it wobbles one way only, the way it was intended, and not sideways. Drive a stub of steel rod into the hole at the grooved end, chuck in three-jaw, and turn the boss. Drill and tap the boss for a set-screw, 4-B.A. being a suitable size, and another stage of the proceedings is over.

### "Condensed Replies"

A reader who is building a 4-6-2, and intending to fit my usual type of combustion-chamber boiler to it, says he was advised by "someone who knows" (?) to leave out the water-tube struts, as they are a potential source of leakage. Tommy-rot! If the struts are left out, the



chamber will promptly collapse under pressure. As for leakage, this is caused only by bad workmanship, and is easily avoided by careful brazing or Sifbronzing; and, in addition, the omission of the tubes would rob the boiler of both valuable heating surface, and a great help to water circulation, in the very place where it is most effective.

The simple oil-burner specified for "Petrolea" can be used on any type and size of locomotive, by merely increasing the size of the pipes and slots. It can be arranged to deliver the spray at the bottom front end of the firebox, through a hole in the blank end of the ash-pan. This should be lined with  $\frac{1}{4}$ -in. asbestos, a "flash-wall" of the same material put at the back of the firebox, covering up the rear air inlet of the ashpan, and a few air-holes drilled in the bottom. No coal bed would be needed; the burner could be started by supplying compressed air to the boiler, and throwing a bit of lighted oily

waste in the firebox to ignite the spray. As soon as the asbestos lining and the "flash wall" become red-hot, the burner will work continuously, same as on "Petrolea." The engines on the G.W.R. which have been converted to burn oil, use the same type of "dribbling" burner.

"It's that man again!" Information has reached me from several sources that the person who intimates that he is "L.B.S.C." is still about. Well, don't be misled; the genuine article doesn't go visiting, for one thing, except to personal friends, or an occasional trip to Maidenhead, and the "spurious" hasn't Curly-coloured hair (recognisable, even though faded) nor could he wear my shoes. I'd dearly love to catch him out, so if any reader who thinks he has met "L.B.S.C." during the past twelve months will write to me direct, or *via* THE MODEL ENGINEER Offices, I'll be greatly obliged.

## A "Lighthouse" Table Lighter

By R. DYSON

SEVERAL pieces of octagonal hardwood arriving amongst a load of firewood suggested an attempt at wood-turning. A table-lighter was decided upon, being both useful and decorative. That it should take the form of a lighthouse seemed appropriate in every way, so a drawing was prepared and a start made on the base.

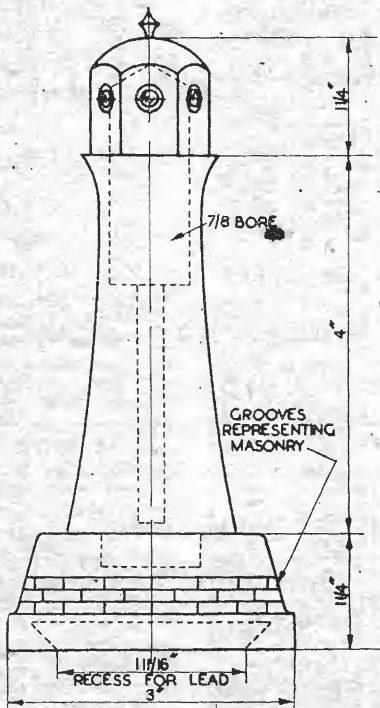
The wood was held in the four-jaw chuck and roughly turned to  $3\frac{1}{4}$  in. diameter. A recess of dove-tail section was bored to receive molten lead, which was now poured in and allowed to cool. For the next operation the base was held by means of a screw chuck, and turned to finished size and form, radial grooves being cut at  $\frac{1}{8}$ -in. spacing to represent joints in the masonry. A 1-in. diameter dowel-hole was bored to receive the body of the lighthouse.

The body was held on a screw-chuck and roughed out, the final profile being turned to a cardboard template made from the drawing. A  $\frac{7}{8}$ -in. diameter hole was bored  $1\frac{1}{8}$  in. deep in the top end, to receive the lighter tank, and a  $\frac{5}{16}$ -in. diameter hole was drilled  $2\frac{1}{2}$  in. deep from the bottom of the bore to hold a small sewing-machine screw-driver for adjusting the flint. The whole length of the body was grooved, like the base, with a screwing-tool, and a 1-in. diameter dowel peg turned on the bottom end to be a tight fit in the base.

The two parts were now assembled by gluing and allowed to set. A small chisel, with an  $\frac{1}{8}$  in. wide point, by  $1/32$  in. thick, was filed up from  $\frac{1}{8}$  in. diameter mild-steel and used to make vertical grooves between the horizontal ones. Spacing was done by eye, and care was taken to stagger adjacent rows. This produced a realistic imitation of masonry. The lighthouse was now given a final sanding and a piece of green baize stuck over the base to eliminate any risk of scratching the furniture. The body of the lighthouse was stained black and the base light brown.

The lighter part was taken from a utility lighter, a new tank being made to suit the "works," but of larger capacity than the original. A cap was turned up from hexagon brass,  $\frac{1}{8}$  in. across the flats, to a "German helmet" design and bored to suit the utility lighter. In the centre of each face of the hexagon, a  $\frac{1}{4}$ -in. hole was drilled and glass brilliants from an old brooch were glued in with "Duroglue."

The lighter was approved by the local domestic authority and now stands on the mantel-shelf. The inclusion of the screw-driver has been well worth while, saving many a trip to the workshop when the flint needs adjusting.



# "Balmoral"

A "first attempt" brought to a successful conclusion after three years of endeavour

By A. L. BRATCHER



*The model P.S. "Balmoral" on Harpenden pond, August, 1945*

THE photograph shows the end of a three-year story. In August, 1942, I wrote to the General Manager of the Southampton-I.O.W. Steam Packet Co. for any particulars they could let me have of their very successful excursion paddler *Balmoral*. There were no drawings existing, and so it was all done mostly from photographs of my own taking some years ago. The result, exhibited at Vauxhall Motors show, in 1944, and very flatteringly featured in a subsequent issue of *THE MODEL ENGINEER*.

After abandoning the difficulties of making a 2-cylinder diagonal slow-speed steam engine closely resembling the original, I reluctantly went over to electricity, and made up a motor from the remains of a Hornby locomotive; re-wound the armature for 6 to 12 volts, and supplied the current from four cycle-lamp 3-volt batteries. Three of these are in series to produce 9-volts, and the remaining one can be switched in when the others begin to give up the ghost. A further small battery provides light, and very pretty the boat looks, in the dark, with lighted ports and windows.

I had a lot of trouble getting the boat stable. The beam is only 5 in., and the draught  $1\frac{1}{2}$  in. +  $\frac{1}{8}$  in. brass keel.

Eventually, by skimming off top weight, I managed it, and now there is no danger of capsize; but as the sponsons are only  $\frac{1}{16}$  in. above the water, they are inclined to stick if

the wind does heel her over. So I grease the sponsons to lessen the capillary attraction, and, as she is only usable in a more or less calm, she has merely to recover from a roll, which she does.

It was Sunday, August 26th, 1945, when the photograph was taken on the pond at Harpenden; and thus ends my first serious model making experience.

The conclusions I have reached during this time may be summarised thus:—

- (1) A scale hull (narrow beam and light draught) can be made stable; but I see every temptation to increase these vital dimensions. By working to "scale" lightness on top hamper and doing everything to get the lowest c.g., there is no need for exaggerated draught if the model maker is keen enough about it.
- (2) Although I found no difficulty in making a pair of nine-float feathering paddle-wheels (3 in. diameter centre of floats) the speed must be (for the given diameter) not less than 100 p.p.m., i.e., about twice full-scale speed. Even then the speed is very slow, but quite realistic. This, of course, limits its use to calm weather.
- (3) If I built the boat again, I would make it larger; the displacement of 200 cu. in. does not allow sufficient margin for the propelling machinery.

## The Cardiff Society's Exhibition

THE exhibition held recently at the Y.M.C.A., Cardiff, in conjunction with the Cardiff West End Model Yacht Club, can be said at once to have been an unqualified success.

This may be deemed to have been assured at the very outset, inasmuch as Alderman J. Griffiths, in his opening address, remarked that such a show should have been staged in no less a place than the Assembly Room at the City Hall, which fact heralds well for our undoubted application for this privilege next year; incidentally, there was also good news for boat fans, in the form of definite plans for a pool, sponsored by the Corporation, in the not too distant future.

In view of the lack of space (the entries far exceeded expectations) and the fact that it was the Club's initial post-war show, the members have, indeed, reason to be well pleased with the result of their efforts, and the steady flow of visitors, well over 1,500 of them, was more than gratifying.

The exhibits were many and varied, pretty well every section one can think of being represented, and a musical setting was aptly provided by means of a radiogram and a model roundabout of the "switchback" type, a subject for modelling by the way, which calls for engineering, wood-working, and artistic skill.

The number of models to be seen working on compressed air, and in various stages of construction, definitely dispelled any idea the lay

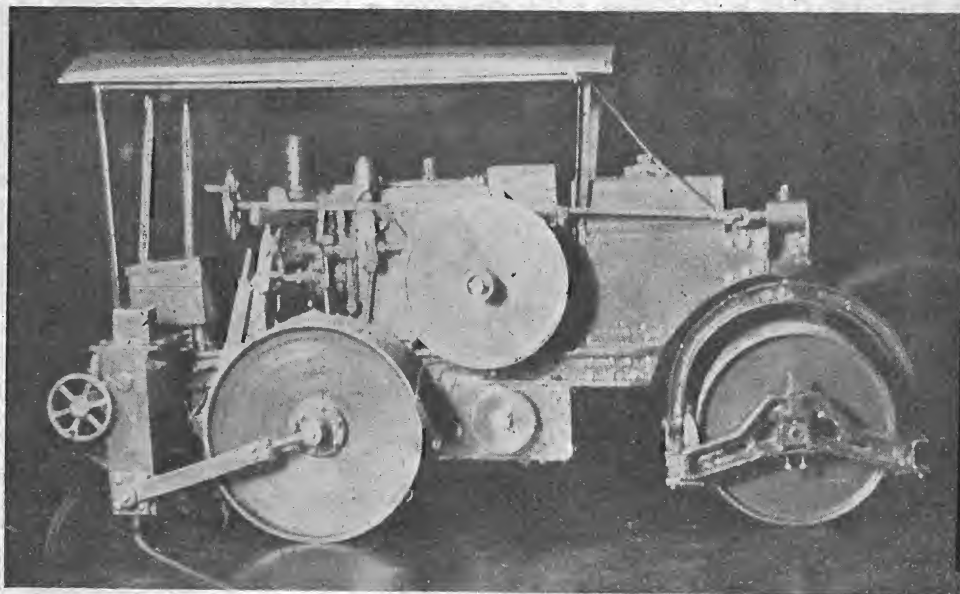
visitor may have formed that a model engineer buys his "bits and pieces" and merely assembles them, and such an opinion could have easily been arrived at, as read the local press heading, "Boy's Paradise," while being correct to a certain degree, was likely to convey the "Toy-shop" impression.

The model yacht section put up a very fine show of exhibits, much interest being shown, especially in the drawings, the hulls in various stages of construction, and the several methods of building involved.

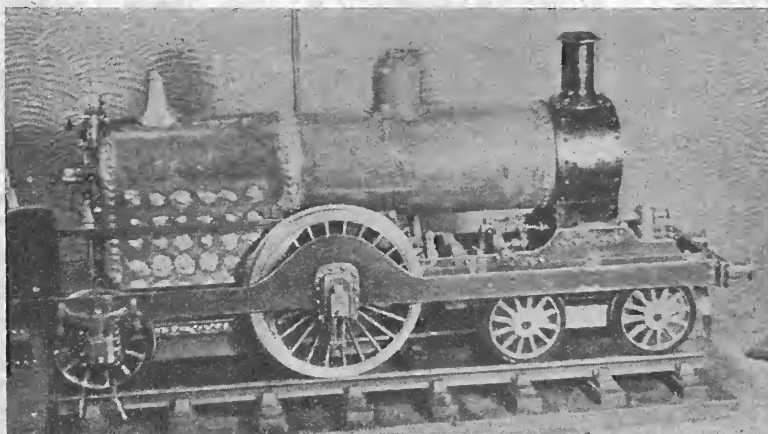
An attempt to describe the show in detail would take up too much time, and, in these times, valuable space, so the Club herewith takes this opportunity to convey its sincere thanks to all those who helped to make the exhibition possible, members and non-members alike, some of whom travelled great distances, at much inconvenience, such was the enthusiasm prevailing.

Also special thanks are due to the several members' wives who were persuaded to act as box-office attendants. Not only did they perform that duty uncomplainingly in draughty conditions, but produced seemingly unlimited supplies of tea and sandwiches, as only women can.

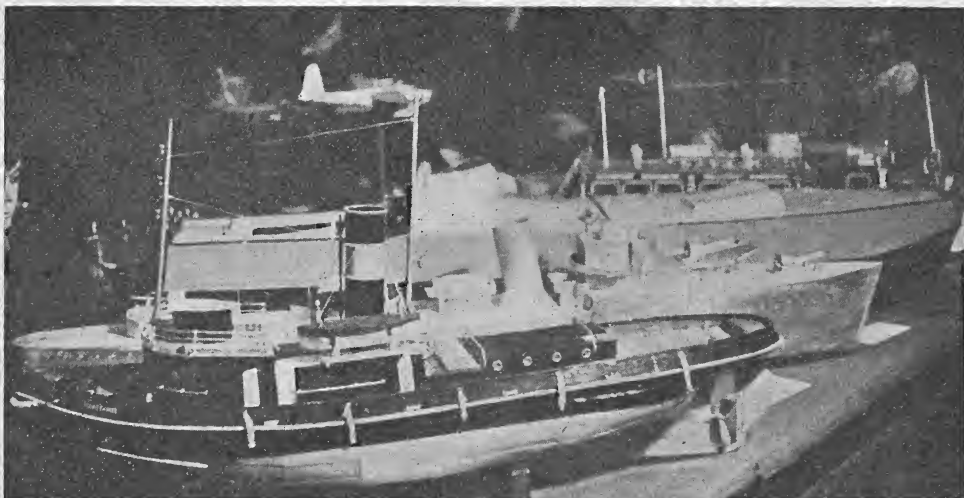
So ended an exhibition ushered in with some trepidation on the part of the sub-committee, who learned many useful lessons in the attempt, the success of which, I am sure, will be a spur to greater things next time.



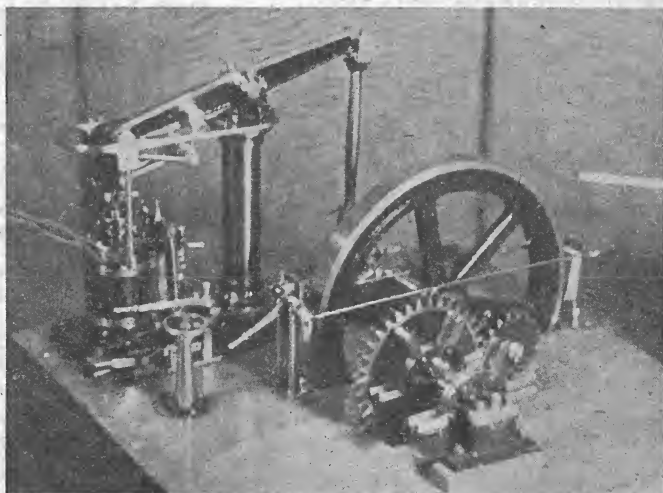
Mr. C. R. Amsbury's "M.E." road roller, commenced when 16 years of age!



*Mr. Munro's model  
single express loco-  
motive*



*On loan from Newport —  
Mr. Hall's ocean-going  
tug "Constance," with  
Mr. Angwin's "J" class  
destroyer (unfinished) and  
steering boat in the back-  
ground*



*Mr. Fryce-Williams' model  
1860 period beam engine*



# The Handyman 100 Years Ago

By G. A. GAULD

## I — Introduction

MODEL making must be one of the oldest handicrafts in history; the ancient Egyptians made models thousands of years before the Christian era; clockwork automats were the rage in the palaces of prince and noble during the middle ages; but popular model making today is a product of the machine age, the machine in miniature, with or without a prototype.

A hundred years ago, the term "model engineer" was unknown, but in this country, at least, there was a body of men engaged in the new industry of engineering whose outlook on life must have been very similar to that of the model engineer of today.

The power of steam was beautifully represented in the beam engine, then at the height of its perfection; but the demands of steam propulsion for ships and other special applications called for new types; there was limitless scope for design in these virgin fields. Iron had not yet given way to steel; iron ships were still something of a novelty; practical shipbuilders were busy with the problem of paddle wheels versus screw; electricity was little more than a scientific toy, but who cared! With the stupendous background of steam power to inspire him, it is little wonder that the factory mechanic went home at night to his back-yard workshop, there to build and to make, and to dream of the discovery that would bring him fame. It was happening around him almost every day.

Even at work, there was not a great difference. Mass production was, as yet, unknown. An engine would be ordered for a specific purpose; the problem would be new and would, no doubt, tax to the utmost, the ingenuity of the designer and his draughtsman. In the shops, each part would be made with that pride of craftsmanship which is rarely seen today outside the amateur workshop. In this respect alone, the mechanic of a hundred years ago had a strong and common bond with his modern descendant, the model engineer.

But there is one marked difference; a hundred years ago, the working mechanic did not have the privilege of a good general education to help him in his specialised studies. This was a serious drawback and much laborious work might have been avoided by the individual experimenter had there been a wider diffusion of current knowledge and the theories underlying mechanical practice. Yet in spite of this, there was always the possibility of stumbling over something new and adding to the general pool of knowledge. Failing this, by the practical demonstration that the invention would not work, the inventor educated himself and his immediate associates. Then, no doubt, he would seek out the reason as to why it would not work.

The scientist might be able to tell him and even the scientist might derive profit from the experiment carried out.

Subjects such as mathematics were highly developed and analyses of practical problems may be found in contemporary journals which would make very tough reading for the average model engineer! To a certain extent, this was true of the sciences generally, but this expert knowledge would appear to have been confined to very few. In marked contrast, many of the practical problems set forth appear elementary today. No doubt, because they were essentially *practical* problems, the scientific professor would have found their solution equally difficult. Nevertheless, the gap between "theory" and "practice" was very wide, far wider than today, in spite of the remarks contributed to these pages from time to time!

The elementary nature of these practical problems as viewed from our angle, makes it extremely difficult to understand how really difficult they were for the men who originally overcame them. It has to be realised that each step taken was a step in the dark. Not only had the step to be conceived in the mind of the inventor, but it had to be put into practice; tried out in exactly the same way as is done in modern research but without the background of knowledge which today gives an indication of the probable result. Only when the step had been taken and completed in a practical form was the result definitely known. Is this so very different from the position in which the model engineer finds himself when, shall we say, his first miniature petrol engine is nearing completion? In spite of all that he may have read about the subject and the fact that he may have built the engine to a well-known design, there is still that doubt when all is ready for the trial. Will it work?

If that is the position for the model engineer, subtract his accumulated knowledge and the references he may make to current literature specialising in the subject and some appreciation of the nature of the difficulties confronting his hundred year old ancestor begins to take shape.

Because it is interesting to read of these early struggles, the nature of the problems encountered and the methods taken, step by step, by which they were overcome, because controversial views were held on many subjects, just as there are controversial views today; and because of the kindred interest between the model engineer and the ordinary workshop mechanic of a hundred years ago, I hope, in the few notes that are to follow in this series, to bring my readers to an appreciation of the struggles of the old pioneers, who have made their present-day hobby a practical possibility.

(To be continued)



# \*IGNITION EQUIPMENT

By EDGAR T. WESTBURY

*A comprehensive review of the working principles, design and construction of electrical ignition apparatus employed on all types of internal combustion engines*

## Part II—Design and Construction (Continued)

IN all matters appertaining to experimental work, one must be constantly on guard against the harbouring of fallacies; they are the deadly enemies of logical reasoning, and whenever discovered, must be pounced upon and ruthlessly exterminated. I have already referred to certain misapprehensions which exist in respect of the working principles of magnetos, but those which have been discussed so far are mostly concerned with matters of detail. It is still more important to insist on clear thinking in matters which concern the basic physical laws governing the operation of ignition apparatus.

In the course of a recent discussion, it was stated that "in a coil ignition system, the battery is the source of power; but in a magneto, the power comes from the magnet." This is indeed a fallacy, and a very dangerous one. The magnet in any form of dynamo, magneto, or other electrical generator, is not a source of power, but simply a medium whereby mechanical power may be converted into electrical energy. No matter what form of magnet, permanent or

electrically excited, whether large or small, powerful or weak, the amount of electrical energy (wattage) generated depends entirely on the mechanical power expended, allowing for inevitable losses at all stages in the conversion process.

This does not mean to say that the efficiency of the magnet is of no importance; to make such an assumption would be to contradict all I have said about the design of small magnetos. A highly efficient magnet is absolutely necessary to enable a small magneto to handle the power input effectively, but the power itself must be applied by mechanical means. By recourse to the much-degraded art of analogy, one might compare the magnet to the main-spring of a clockwork mechanism; a small but heavily-stressed spring may be capable of producing as much energy as a large but more lightly-stressed spring; but in either case the spring itself is not the actual source of power, which must necessarily be first put into the spring by the act of winding it up.

It is very common to regard a magnet as a source of free energy, but in actual fact the *apparent* energy which it contains can only be utilised in practice by moving it mechanically or varying its attractive force electrically.

\*Continued from page 123, "M.E." January 31, 1946



The Banks micro-weight ignition coil

### Power Required to Drive Magnetos

Consideration of the above leads naturally to the question of the amount of power required to drive small magnetos of the type which have been described in these articles. Many users of small petrol engines have been very reluctant to risk the reduction of engine power which they consider must inevitably be involved by fitting a magneto in place of coil ignition. In some cases, comparisons have been made with estimates of the power required to drive full-sized magnetos, and the results of calculations made on this basis are, it must be allowed, somewhat terrifying.

It has always been my opinion that the power absorbed by a magneto on a car or motor-cycle

miniature magneto must do the same job as its "prototype," it must necessarily take just as much power to drive. Neither idea is correct. Even if the miniature produced as high an output voltage as a full-sized magneto, the actual electrical energy, or wattage, is not necessarily the same. Voltage should never be confused with actual electrical power, because it may be accompanied by very little current discharge, and every elementary electrical student knows—or should know—that wattage is the product of volts and amperes. One of the main points in the development of the miniature magneto has been the production of an effective ignition spark on a very small amount of energy. Another factor which has enabled the expenditure of

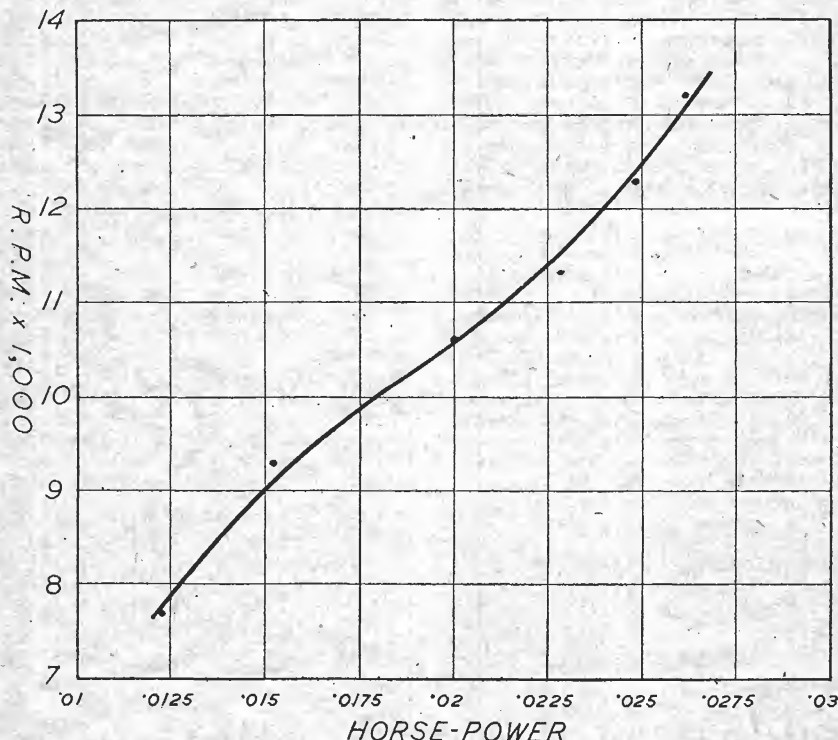


Fig. 71. Graph showing power absorbed in driving a miniature magneto, prepared from test data furnished by Mr. R. H. R. Curwen

is much less than is commonly estimated. Some years ago I had the job of fitting up a large polar inductor magneto for use as a laboratory demonstration model, and it was proposed to drive it by means of a small electric motor, up to a maximum speed comparable with that at which it would run under normal working conditions. The makers of the magneto were rather non-committal when consulted on the question of how much power this would take, but reference to a text-book, which gave the power absorption of auxiliary machinery on aircraft engines, gave the figure as  $\frac{1}{3}$  h.p. It was eventually found by trial that the desired result could be obtained with a  $\frac{1}{3}$  h.p. motor!

The opinion is often expressed that, as a

mechanical power to be reduced is the careful design of mechanical working parts, including the contact-breaker, with the object of reducing friction and inertia wherever possible.

Much of the power absorbed by a full-sized magneto is accounted for in the friction of the bearings, which are usually of the heavy-duty type, designed rather for durability than for easy running, and the driving mechanism, which may consist of chains and sprockets, or some other form of toothed gearing. It is often possible to eliminate, or very considerably simplify, the driving gear on a small magneto, or even to dispense with separate magneto bearings, by building it into the engine structure, as I have suggested in previous articles.

The use of a contact-breaker with a very light action will also make a decided improvement in power economy, and this aspect of the matter has also been carefully studied in the development of these magnetos.

As regards the actual electrical load involved, I have stated that a small magneto will function on as small an amount of energy as one watt—this being the energy actually generated in the primary by running the machine as an ordinary current generator. Even assuming the electrical efficiency to be extremely low, this represents only a very small expenditure of mechanical power. Taking the accepted figure of 746 watts per horse-power, and a generator efficiency of only ten per cent., the power absorbed in producing one watt is only 0.0135 h.p.

For some time now I have been intending to make actual tests of the power absorbed in driving the "Atomag Minor" and other types of magnetos described in these articles, but have been unable to find the time to do so. Tests of this nature, apart from the time involved in making and fitting up apparatus, call for very careful observation, and cannot be carried out in a hurry.

My default in this matter, however, has been very largely put right by my friend Mr. R. H. R. Curwen, who has constructed a miniature magneto, and has used it with great success in his model racing car. In all matters connected with the development of this and other experimental models, Mr. Curwen has always been most methodical in analysing and testing the various factors in output and performance; and he has recently made some power absorption tests of the magneto, with some very useful and illuminating results.

It should be explained that the particular magneto is one of very similar design and size to the "Atomag Minor," though I claim no share in its development, beyond a few general hints and discussions with Mr. Curwen prior to and during its construction. The rotor consists of a disc magnet of the same type as that employed in the "Atomag," but without any soft iron pole pieces attached, and the shaft runs in plain bush bearings. A contact-breaker

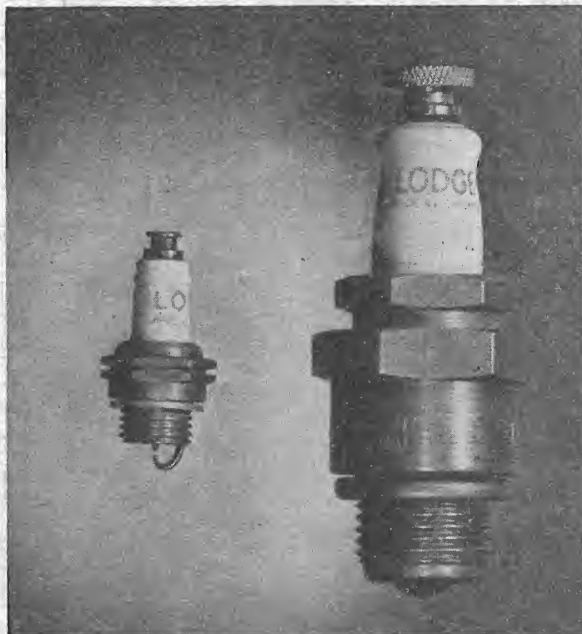
of the pivoted rocker type is fitted, having a duralumin arm operated by a hardened cam. The period of contact is 90 degrees.

The tests were made by using an electric motor pivoted to swing freely in ball races and fitted with a torque arm. Several tests were made, to analyse various factors in the electrical and mechanical functions of the machine, but although all the readings taken are of great interest, and useful to anyone engaged in serious investigation of magneto design, space limitations prevent them from being presented in complete detail here. What most users of magnetos are interested in is the actual amount of power absorbed in driving the magneto under working conditions; and that can be seen at a glance from the curve reproduced in Fig. 71. Most of the readings

are taken at high r.p.m., as that is the condition under which considerations of power absorption are most important, and indeed, the amount of power involved is so minute that readings at low speed become extremely difficult. For this test, a fixed spark gap of  $\frac{3}{16}$  in. in air was used for the discharge of the current, and this produces yet another item of evidence as to the extremely wide range of speed over which the magneto will function effectively.

Although this is an isolated test, the findings of which do not necessarily apply to all miniature

magnetos, it does at least prove what is possible in these machines, if reasonably well constructed, and should convince even the most sceptical reader that they do not act as brakes on highly tuned engines. The maximum amount of power taken, at over 13,000 r.p.m., is little over 1/40 h.p., and it may be of interest to note that considerably more power than this can be expended in driving a coil ignition contact-breaker, if the latter is not very carefully designed. I have stated in an earlier issue that Mr. Curwen's car (which has a 5-c.c. engine) has produced its highest speeds while fitted with the magneto, which tends to suggest that the absolute certainty of ignition at the higher speeds, produced by the magneto, is a valuable asset in the performance of racing engines.



*The Lodge  $\frac{3}{8}$  in.  $\times$  24 t.p.i. miniature plug shown beside a Type C3 standard (18 mm.) plug*

### A Super-Lightweight Ignition Coil

The users of very small aircraft engines have always been very worried about the weight of ignition equipment, and quite rightly so, in view of the fact that in the case of an engine of 1 c.c., this equipment may often weigh much more than the engine itself. In these articles, I have shown amateur constructors how to produce coils as small as possible without undue sacrifice of efficiency; the lightest coil dealt with is about 2 oz., which is as far as it is usually safe to go with ordinary winding facilities; but lighter coils are quite possible if one takes sufficient care and pains in their construction. Unfortunately, however, the battery power required to energise these coils cannot generally be reduced in proportion to their size; indeed, some light-weight coils demand more than their fair share of current, because of their reduced electro-magnetic efficiency. Battery power is nearly always the bottleneck in ignition efficiency with very small engines, and hitherto there has been little one could do about it.

But as I have so often pointed out, the word "impossible" has little place in the engineer's vocabulary, and it often happens that an insurmountable obstacle against which one has been vainly kicking for years, proves to have a path round it or a tunnel under it, if the search is continued long enough. A new discovery in materials, methods or processes, may render feasible a scheme which has always hitherto been regarded as beyond the bounds of practical possibility.

I have recently witnessed a demonstration of a new light-weight coil, which, by the introduction of new methods of winding and construction, achieves an unusual economy in current consumption, enabling the size of the battery to be proportionally reduced. The designers of this coil have had considerable experience of electronic engineering during the war, and their knowledge in this branch of modern science has been turned to good account in evolving an ignition coil capable of producing a spark with the minimum input energy.

In the normal type of ignition coil, the alternate layers of wire and insulating material in the secondary provide the equivalent of a condenser of fairly large capacity—in other words, it is said that the coil has a large "self-capacity." The designers of the coil referred to, being convinced that quite a considerable proportion of the input energy of the battery is absorbed in the useless work of charging this capacity, before any useful voltage can be produced, have tackled the problem by using a new method of winding, in which self-capacity is very considerably reduced. This enables the coil to work with a very small primary current, well within the supply capacity of a normal form of miniature dry battery. The d.c. (or ohmic) resistance of the primary is, in fact, so high that no harm is done to the battery if the engine stops with the circuit closed, and no perceptible sparking takes place at the breaker contacts, which need not be made of refractory material. A most unique feature of the coil is that no condenser is necessary across the breaker contacts, and any attempt to use a condenser of normal capacity results in a partial

or complete quenching of the secondary spark

The specification of the coil, which is known as the Banks Micro-weight Coil, is as follows: Length,  $2\frac{1}{8}$  in.; diameter,  $\frac{1}{2}$  in.; weight,  $1\frac{3}{16}$  oz. Casing of bakelite tube, with pressed-in end discs of same material, hermetically sealed with bakelite cement. Solder tags are provided for attachment of primary and secondary leads, connections being indicated by means of a printed label. The mean working current is approximately 50 milliamperes when operating on a two-cell dry battery, and 90 milliamperes on a three-cell battery, the length of spark produced being 4 mm. Satisfactory ignition can be obtained when using a "Penlite" dry battery (type 1915), in which case the total weight of ignition equipment is 2 oz. all-on.

I have seen this equipment working on a 5-c.c. Kestrel engine, in which starting and running efficiency appeared to be quite normal. The starting operation was performed by means of a hand brace, and the engine turned an air-screw of  $13\frac{1}{2}$  in. diameter by 6 in. pitch, at a speed of approximately 3,000 to 3,500 r.p.m. A mixture of 6 of fuel (Ronsonol) and 1 of lubricating oil, was used. The contacts were of chrome rustless steel, and contact was closed for an arc of 15 degrees.

One of the coils submitted to me for test has been run several times on my coil tester for periods up to 15 minutes at a time, sparking across a  $3\frac{1}{2}$  mm. gap at frequencies up to 6,000 sparks per minute on an input of 3 volts. The appearance of the spark is thin and non-luminous, compared to that produced by coils of the orthodox type, which is to be expected in view of the small amount of energy consumed; there is, however, no reason to believe it is less effective in producing ignition.

The makers of this coil are Messrs. Banks (London) Limited, 111, Clapham High Street, London, S.W.4, who intend also to market miniature sparking plugs of a type designed specially for use in conjunction with the ultra-lightweight ignition equipment.

### More Miniature Sparking Plugs

I am very pleased to bring further good tidings to model petrol engine users regarding the supply of miniature sparking plugs. Messrs. Lodge Plugs, Limited, Rugby, who were one of the first firms in the world to specialise in sparking plug production, and whose reputation needs little embellishment from me, are now producing miniature plugs in the popular  $\frac{3}{8}$  in.  $\times$  24 t.p.i. standard size.

These plugs embody, in a miniature form, all the merits of the larger Lodge plugs, including an insulator of the special ceramic composition "Syntox," which is the exclusive discovery of the Lodge laboratories, and has been used in millions of plugs for aircraft engines during the war, its first use in warfare being in the Rolls-Royce Merlin engines of the Hurricanes and Spitfires which scored such a historic triumph in the Battle of Britain.

The importance of the insulator of a sparking plug, and the extremely difficult electrical and mechanical conditions which it has to withstand, (Continued on page 176)



# A Good Old Servant

By C. J. B. BOVEY

**A**CROSS the river Thames, opposite St. Paul's, is a place known as Bank-side. In the year 1858, there was here the engine builder's works of J. Shears and Sons. From these works came engine No. 915, which had a useful life of 80 years. Not many engines work so long as this, that is why I think it is worth describing and, also, modelling.

The bed was like a long narrow box, consisting of two deep, heavy girders of I section, with the ends built into a brick wall at each end. (She was on the first floor of the building.) The length of the engine proper was 14 ft., which left 3 ft. at either end to walk round her for oiling and cleaning. The width across the two girders forming the bedplate was 2 ft., and they were 2 ft. 6 in. deep. There were cross ribs between them, cast about 4 ft. between them to bind them together.

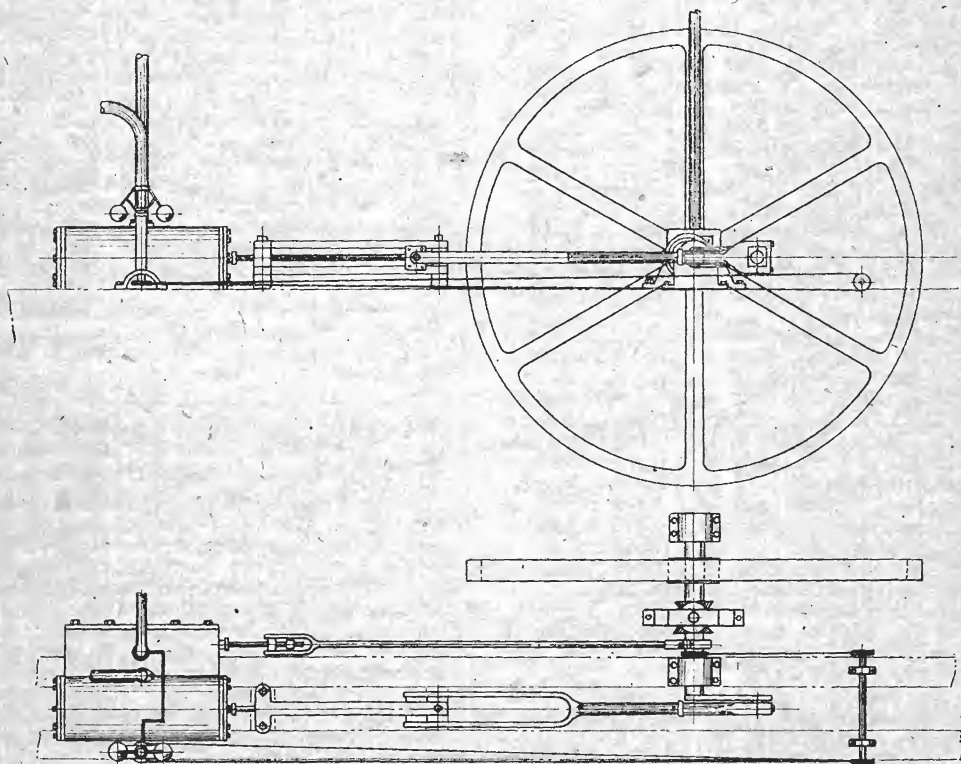
The flywheel, like that of many an old engine,

*A description of an old-time long-stroke horizontal steam engine, built in 1858, and broken up in 1938*

was large in diameter, but narrow in width, being 9 ft. in diameter, and 5 in. wide, with six straight spokes.

The cylinder rested between the two girders of the bed, and was bolted down by two lugs at each end, in under the top flanges of the girders. It was 3 ft. 4 in. overall length. The covers were 15 in. diameter, and  $\frac{7}{8}$  in. thick, and each had eight  $\frac{3}{4}$  in. diameter studs. The piston-rod was 1  $\frac{3}{8}$  in. diameter.

The crosshead was like those of outside cylinder locomotives, and moved between a top and bottom single guide-bar; these were shaped like the letter "T" turned sideways to the left (from a plan view), 3 ft. 8 in. long, and 1 ft. across the top of the T; they were bolted to two of the cross ribs between the girders of the bed, having two bolts at cylinder end (top of the T) and one at the opposite end. These bolts were 1  $\frac{1}{2}$  in. diameter, and passed right through the top and bottom guide-bars, with distance-



*Elevation and plan of engine No. 915*



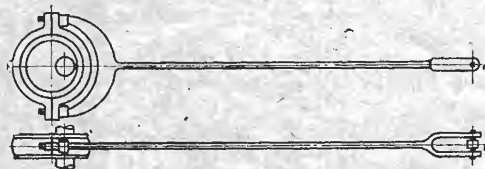
pieces on, to keep the two bars the right distance apart. Each bar was a casting, planed where the crosshead moved, and was 3 in. wide on the planed parts.

The crosshead was made of brass, in two halves, bored out 2 in. to take the pin of the forked connecting-rod (this pin was fixed solid in the rod). Four bolts,  $\frac{1}{2}$  in. diameter, with lock-nuts, passing horizontally through the cross-head, bolted the two halves together. The length of the crosshead was 5 in.

The connecting-rod was of the forked type, seldom, if ever, seen today. Each prong of the rod moved either side of the guide bars; the crosshead pin kept the ends of the prongs solid.

The big-end, or crank-pin brass, had a round "neck" which was bored to receive the end of the connecting-rod, and went on the rod 6 in., up to a collar turned solid on the rod, and kept in place, by a cotter-pin through it. The forks were 8 in. wide over all, each prong was 1 in. wide and  $2\frac{1}{2}$  in. deep. The round part of the rod tapered  $2\frac{1}{2}$  in. to  $2\frac{1}{4}$  in. near the collar. The total length of the connecting-rod was 6 ft. 8 in.

The single crank-web, or arm, was 4 in. wide, and 15 in. centres, crank-pin to centre of shaft. This gave her the long stroke of 30 in., which



*Rough sketch of eccentric-rods, showing the claw and forked ends*

was three times the cylinder bore of 10 in. In modern engines, most have an equal bore and stroke; but this old engine ran at only 60 r.p.m.

The crankshaft was  $4\frac{1}{2}$  in. diameter; the end opposite the crank-web rested in a bearing built into the wall. The flywheel was near this bearing, and a hole in the floor was provided to accommodate part of the wheel.

The eccentric-rod was  $1\frac{1}{4}$  in. diameter, and was also of an unusual type. At the strap end, were two radius-arms like claws. A  $\frac{3}{8}$ -in. stud was in the end of each claw, and passed through the lugs of the brass sheave straps, with lock-nuts on the ends. Instead of the eccentric-rod end being joined to the sheave strap in the usual way, one of the straps lay inside the two claw arms. (Some of the old side-lever marine engines had this type of eccentric-rod.) The other end was provided with a small fork which had a "prong" along each side of a square guide-post screwed into the bed. Through a hole in this post, worked the end of the slide-valve spindle, with the forks of the eccentric-rod attached to it by a square block working on a pin through the ends of the forks.

The governor had two 5-in. diameter balls, and was of the early Watt type. It was driven by two round leather belts, in this way:—At the crankshaft end of the engine, across the bed was a small shaft,  $1\frac{1}{2}$  in. diameter, with a

5-in. diameter pulley each end. A V-groove in each pulley took the round driving belts. A short belt drove this shaft from a pulley on the crankshaft just inside the crank bearing. A long return belt from this countershaft, ran nearly the whole length of the engine, to a pulley at the base of the governor, which was bolted to the bed beside the cylinder, on the opposite side to the steamchest. The centre-line of the engine was 7 in. above the top of the bed.

A vertical shaft, driven by two bevelled gear-wheels, in the centre of the crankshaft, took the power drive of the engine, up to the floor above, and another pair of bevelled gear-wheels drove a line shaft, on which three pulleys drove three machines by belts.

This old engine was broken up in 1938, after working for 80 years. Had I been her owner, I should have presented her, for honourable retirement, to the Science Museum, South Kensington.

### Remarks on Making a Model

I am building a model, roughly  $\frac{1}{4}$  in. to 1 ft. scale. Instead of a girder bed, I am using a piece of  $\frac{1}{2}$ -in thick steel-plate, screwed to a wood block, with slots for flywheel and crank-arm, and an ordinary pulley on the crankshaft for drive, instead of a vertical shaft. I am also making the stroke only twice the cylinder bore, as I think three times the bore is rather too long for a model. I have no lathe, only a small bench in the garden, a small drilling-machine, and a few files. I have cut the flywheel from  $\frac{1}{8}$ -in. scrap steel-plate. The spokes I chain-drilled by hand, finishing with chisel and file, an operation that took three months! So I shall be some time yet!

My model is now just over half finished, and everything has been cut from solid metal. To those who own a workshop with a lathe this old engine would be easy to make.

Many people prefer these old, slow-moving engines for models, as they please the eye, much more than the modern, high-speed, enclosed types, where only the flywheel can be seen.

A model of this old engine could be made, and would look nice, with the double-arm, or whole crankshaft, instead of the single, or half-crank type.

### IGNITION EQUIPMENT

*(Continued from page 174)*

have already been described in these articles, but it may be said that "Syntox," in addition to heat resistance and mechanical strength, has a better heat conductivity than that of ordinary ceramics, and thus conducts heat away from the central electrode of the plug, enabling it to run under conditions which would otherwise cause failure through overheating.

Lodge miniature plugs are sold at the popular pre-war price, and will shortly be available from all dealers. I am indebted to Mr. G. S. Davison, of Motor News Service, for details and photograph of these plugs.

*(To be continued)*

# A Simple Vertical Engine

By W. WHITE

HAVING derived much pleasure from time to time studying the various types of simple steam engines built and submitted by readers of THE MODEL ENGINEER, I find myself tempted to display my own modest effort; consequently, I submit a photograph and short description of same.

The engine is  $\frac{3}{4}$ -in. bore,  $\frac{3}{4}$ -in. stroke, and is single acting. It is constructed almost entirely of brass, with the exception of the silver-steel columns ( $\frac{5}{32}$  in. diameter), connecting-rod ( $\frac{5}{32}$  in. diameter), valve-spindle ( $\frac{3}{32}$  in. diameter) and steel eccentric.

The sole-plate is 3 in. square and  $\frac{5}{16}$  in. thick.

The overall height, from top of soleplate to top of cylinder cover, is  $3\frac{3}{8}$  in.

The height from top of soleplate to underside of cylinder-flange is  $1\frac{13}{16}$  in.

The column centres are : fore and aft,  $1\frac{1}{4}$  in.,

athwartship,  $1\frac{1}{2}$  in. The crank is of the disc type, and the shaft is  $\frac{3}{16}$  in. diameter.

The flywheel is  $1\frac{3}{16}$  in. diameter and  $\frac{5}{8}$  in. broad. The displacement lubricator is home-made and is  $\frac{7}{16}$  in. diameter and 2 in. long.

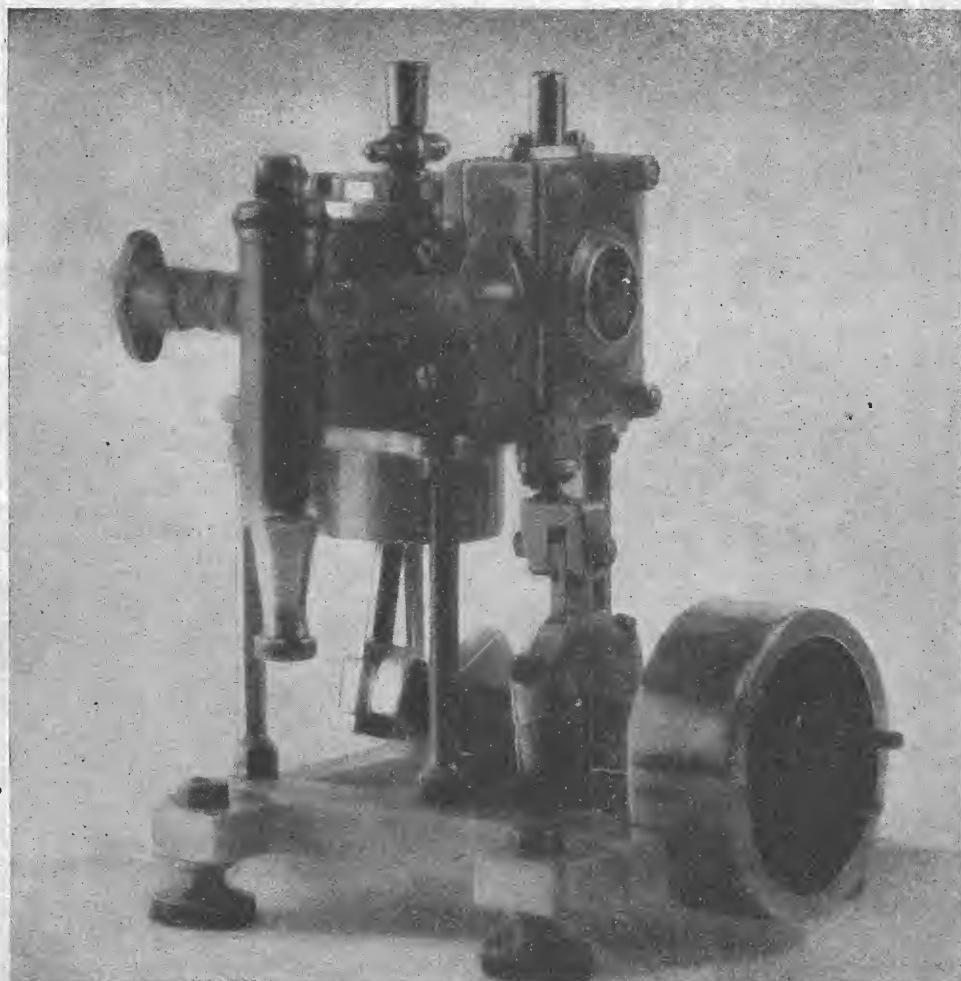
It will be noticed that the valve-chest extends above the top of the cylinder; this is to allow the steam-post to be drilled and filed straight through.

The cylinder is simply a piece of brass tube with a bossed flange slipped on to take the top of the column. The boss keeps it dead square with the cylinder.

The valve-casing is bolted to a block sweated to the cylinder wall.

The cylinder valve-chest centres are  $\frac{1}{8}$  in.

Unfortunately, I have no workshop or lathe, but managed access to a friend's to do the necessary turning.



# \* A CONGREVE CLOCK

By Dr. J. BRADBURY WINTER

*Details, dimensions and instructions  
for making an attractive timepiece*

ALMOST all the arbors in the clock are  $\frac{1}{4}$ -in. silver-steel, and if a D-bit is made of the same material it will save a lot of trouble when making bushes and sleeves. As a rule, these are wanted to be tight on the arbor to begin with, so the steel for the D-bit should be put in the three-jaw projecting a couple of inches, and while running fast, pull a strip of emery-cloth backwards and forwards bent over it, for half a minute. Then file the flat on it, theoretically exactly a semi-circle in section, but better a shade too big than too small.

The pin for the top end of the connecting-rod is shown in Fig. 14. The long threaded portion is provided in case a small weight should be required for balancing the plate; this would be in the form of a disc between the nut and washer. The connecting-rod is just a strip of mild-steel  $\frac{1}{16}$  in.  $\times$   $\frac{1}{16}$  in., with a brass bush at the lower end, having a flange  $\frac{1}{16}$  in. thick on its outer side. The top end is not bushed. Cut the rod a little too long; drill the top hole and broach it to fit the pin. The exact length can be marked on the rod with the rocking plate and crankshaft in place. Assemble the plates on the pillars, with the crankshaft. Slack out the rocking pivots, put the plate between them and adjust them so that the lever has  $\frac{1}{32}$ -in. clearance from plate "A." Block up the rocking plate with bits of packing till it is the same distance from the tops of the plates on each side. Any error here will reappear when the clock is finished, for since the plate must be level, the whole clock would have to be tilted over like the leaning Tower of Pisa.

The top end of the connecting-rod being on its pin at the centre of the slot, mark the other end to correspond with the centre of the crankshaft, the crank disc being removed. Take it off, drill it, and bush it, broaching the bush to fit the crankpin.

We can now pass on to the crankshaft accessories. First the eccentric; all in one piece from a brass rod 1 in. diameter. No description necessary; but, for what it is worth, I will say how I should make it myself, though nobody need copy me. I should face-off the end of the rod, and part it off at  $\frac{1}{8}$  in. full; centre-pop on the parted-off side  $\frac{13}{64}$  in. from the edge; solder the faced-off side on the end of a bar eccentrically, with the centre-pop central to eye. Set it up to run true, using my  $\frac{1}{4}$ -in. pointed bit of steel; drill and bore and finish with the

D-bit. With a round-nose tool, face off till the disc was  $\frac{5}{64}$  in. thick, leaving the boss a good  $\frac{3}{8}$  in. diameter. Melt off, wash and rinse.

Having got so far independently, we can go on together. Drill a  $\frac{1}{4}$ -in. hole through the sheave, its centre  $\frac{3}{16}$ -in. from the edge at its farthest from the bore, and broach it from the boss side so that tapered plugs can be inserted for balancing. This can be done quite easily when the clock is going, without stopping it. Make one such plug now, about  $\frac{1}{4}$  in. long, tapered to fit the hole; others, of different lengths can be made later if wanted.

If the D-bit was made correctly, the crankshaft will not enter the bore. Put the shaft in the three-jaw and polish it with emery cloth till the eccentric will go on; but go carefully, it may slip on a little way, but we want it to fit tight when it gets home, boss side of sheave about  $\frac{3}{8}$  in. from the shoulder. Rotate it on the shaft so that it hangs vertically downwards when the crankpin is at the top dead centre, that is to say, when it is in line with the connecting-rod, not when the crankpin is on the vertical line. Drill the boss and shaft, and broach for a tapered pin. Put the broach handle in the three-jaw, measure how far the point projects from the boss when pushed in as far as it will go, the operation must be continued until it projects an additional amount equal to the length of the hole, in this case a full  $\frac{3}{8}$  in.

For beginners, broaching in the lathe will probably hang up and break the broach if not done properly. Oil it, keep on pressing it gently and withdrawing it an inch or so every second, like a pendulum beating seconds; it will not snatch if you do this. When done, take the broach out of the chuck, clean it and clear the hole with it quite free of chips. Make the tapered pin at once, before taking the eccentric off the shaft; silver-steel a little too large in the three-jaw; high speed. With a dead-smooth file, taper it like a broach, which is surprisingly little. When it goes through the hole, note how much the point projects, then try it in the other end, it ought to enter the hole as far as it previously projected and no more. If it goes in farther than it projected, it is too tapered; file more off the left end. It is best to file a reasonable length, say, an inch in this case.

Having got the taper right, polish with emery sticks. Wipe it clean, push it in tight with a little twist, snip off the point, say  $\frac{1}{8}$  in., beyond the boss, withdraw the eccentric off the pin, round the end and polish it with emery sticks used first like a file, and finishing by holding them still for a couple of seconds to give a

\*Continued from page 127, "M.E." January 31, 1946.

circular grain. Push it tight in the boss again, remove it from the chuck and snip off the wire to project the same as at the point; tap out the pin with a hammer, put it in the three-jaw and round and polish its head.

I have thought it worth while to write all this; there are many tapered pins, let them all be made in this way; they will never work loose, but are very easily tapped out. Make a brass punch for this purpose, also a heavier bit of brass to hold against the boss on the far side, say 7 in. or 8 in. of  $\frac{3}{8}$ -in. rod faced off flat. If tapered to about  $\frac{3}{16}$  in. diameter, with a hole about No. 35 to drop over the head of the pin, all the better. An assistant holder-up is most welcome.

The two-spoked lever is the next item, made of mild-steel, all in one piece with the boss. Cut off a piece of  $\frac{7}{16}$ -in. square steel, and saw it down from each end to leave a square boss in the middle, as was done for the rocking lever. Solder it on the faced-off end of a scrap of stout tube or bar. Set it up true to a centre-pop in the middle of the boss; turn this to a good  $\frac{3}{8}$  in. diameter, and face off the arms to  $\frac{1}{8}$  in. thick. Drill, bore and D-bit the hole. Melt off and file to shape, leaving the arms a little too long. A short flat is filed at each end, pointing to the centre, on which a scrap of watch spring is soldered, as shown in Figs. 6 and 7, side and front elevations. Experience has proved this to be necessary to prevent wear. Note which way the lever turns, anti-clockwise.

Remove the eccentric from the crankshaft.



Fig. 14 CONNECTING-ROD PIN

The lever will slip on a little way and then fit tight; ease the shaft with emery-cloth until it fits tight in its proper place, centre of arms  $1\frac{1}{8}$  in. from the shoulder at the bridge-plate end. Be careful not to overdo the polishing, it must "stay put" until it is pinned. The eccentric will, of course, slip right home after this, but that is quite in order, we only want the pieces tight for the operation of drilling. Be sure to oil the shaft when trying it in the lever or it may seize; avoid twisting, tap it out with a hammer if necessary. Having got it to its place on the shaft, its exact relationship with the crank will be found after the armature and bobbins are in.

The bobbins can be taken from an old electric bell on your electrician's scrap heap. Select a good solid make of suitable pattern. The framework to which the cores are riveted can be cut and adapted to be screwed on plate "B" as in Figs. 6 and 7, side and front elevations.

The armature is shown in detail in Fig. 15. A piece of  $\frac{1}{16}$ -in. sheet-iron or steel is soldered into a flattened recess filed in  $\frac{1}{4}$ -in. silver-steel. A small hole at the side is for a spiral spring to pull it away from the bobbins. A window is cut in it corresponding with the tips of the two-spoked lever, so that it will not get trapped if the armature is released before the lever is clear. Two brass rivets are put in to correspond with the centres of the bobbin cores; they should

not project more than  $1/64$  in. After the circuit is broken, the bobbins still retain a certain amount of residual magnetism, and if the armature were in actual contact, the weak spring would fail to pull it away. Two pins are pushed tight in plate "B," one has a groove round it for the spiral spring to hook over, the other is a stop to prevent the armature getting more than  $1/32$  in. from the bobbin cores. Use very fine wire for the spring, and let it be as weak as possible. The pins should be tapered to fit broached holes in the plate, projecting  $\frac{1}{8}$  in. on

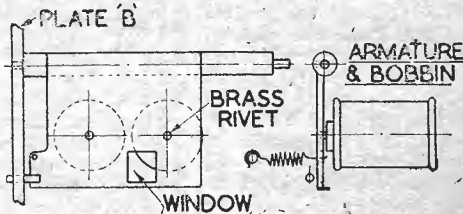


Fig. 15

the far side so that they can be easily tapped out if they should be in the way. A piece of watch spring is to be soldered on the bottom edge of the armature.

With the bobbins and armature and crankshaft in position, the tips of the two-spoked lever can be carefully filed to overlap the armature a good  $1/32$  in. when engaged, and just to escape when it is pulled back. The lever should be horizontal when the crank is in line with the connecting-rod on a dead centre (not vertical). Don't risk seizing up by twisting the lever where it is tight on the shaft. If too tight for this, a tap with a brass punch will shift it to an easier place, then twist it until the crank is on a dead centre when the lever is held up by the bottom edge of the armature. If it was punched along the shaft, punch it back to its right place and test again. Drill and broach for a tapered pin, and make the pin.

The thin wheel of somewhat finer pitch which engages with the fly pinion, and the 20-toothed wheel, are mounted on a bush common to both, a tapered pin securing it to the crankshaft.

#### FLY & PINION

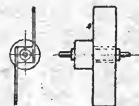


Fig. 16

These two wheels will be pushed on the shaft from its inner end. Start by making a plug gauge to fit the bore of the 20-wheel. Then chuck a scrap of  $\frac{1}{2}$ -in. brass rod, projecting far enough to enable you to turn down both ends to fit the wheels in one chucking. Skim the rod to run true; turn down a length of about  $\frac{1}{4}$  in. up to a sharp shoulder to fit the big wheel. Turn to a similar shoulder from the chuck end, facing the opposite way, to the same diameter as the gauge. The distance between the shoulders is  $7/32$  in. Drill, bore and D-bit the hole, and part off at  $13/64$  in. from the left shoulder.

Push the bush on the crankshaft, after



applying emery-cloth as usual, the parted-off end being  $1/64$  in. from the pivot shoulder. Drill and broach for a tapered pin; make and fit the pin; remove the bush and give another touch of emery-cloth to the shaft to make it a "glove" fit. The wheels are then to be pushed on the bush. Clock-makers always rely on their being sufficiently tight without solder. Personally, I prefer to fit them moderately tight, and run a fillet of solder round to make sure. You are free to follow the professional or the amateur as you like! But if the latter, remember the soap and rinsing.

All the big wheels in the main train have 95 teeth, and are 3 in. overall diameter; the small 20-toothed mild-steel wheels cut to gear with them, come out at a bit less than  $\frac{3}{4}$  in. diameter overall. A gauge is to be made as a jig for the distance between the pivot holes. A strip of brass, say  $\frac{1}{2}$  in.  $\times$   $\frac{1}{8}$  in.  $\times$  4 in., has a hole at one end drilled and broached to fit the  $\frac{1}{2}$ -in. arbors without shake. Another hole, say No. 40, is drilled at a distance equal to the measurement between the centres of a pair of wheels deeply engaged and laid on the bench. A temporary bush (or it may be the permanent one) is fitted to each wheel, one bush fitting on the  $\frac{1}{2}$ -in. silver-steel, the other having a No. 40 hole, or whatever size was drilled in the gauge. The two wheels are then tested for depth of engagement by placing them on the gauge pivot holes and rotating them. Probably they will be found to bind, being too deeply engaged. The gauge is then to be stretched by hammering in the middle until the engagement is perfect, just a slight amount of play between the teeth.

We want to drill a temporary pivot-hole in plate "B" for the fourth arbor, which carries the 95-wheel in the  $\frac{1}{2}$ -in. housing space, under the triangular plate. Take the wheels off the crankshaft, lay the distance gauge on the plate, pass the crankshaft through it, and the pivot into its hole in plate "B." Rotate the gauge until the No. 40 hole is as near as possible to the position shown in the side elevation (Fig. 6),  $3\frac{1}{2}$  in. from the top of the plate. Cramp the gauge on the plate, and using it as a jig, drill the No. 40 hole.

Now cut out the triangular plate roughly to size from  $\frac{1}{8}$  in. sheet-brass. Centre-pop the pivot hole, and with the compasses set at  $1\frac{1}{4}$  in., mark off the holes for the three pillars; (two of the holes and the pivot hole are in a straight line). Drill the pivot hole, No. 40, and the holes for the pillar screws, 3-B.A. tapping size, to be enlarged later. Cramp the triangular plate in correct position on plate "B," with the shank of the 40 drill passed through the pivot holes. Produce the pillar screw holes through plate "B." Remove the triangular plate and enlarge its screw holes by broaching until they will just allow the screws to pass through. Tap the holes in plate "B."

Cramp plates "B" and "C" together, with plugs in two main pillar-holes. Produce the No. 40 pivot hole in "B" through "C." The hole in "B" has served its purpose as a jig, and is now to be enlarged to about  $\frac{1}{2}$  in. diameter, giving easy clearance for a 20-toothed wheel to pass through.

Make the three pillars,  $\frac{1}{8}$  in. diameter,  $\frac{1}{2}$  in. long, and drilled clearance size for the 3-B.A. screws. Assemble the triangular plate with its pillars on "B" and plates "B" and "C" on the main pillars with the nuts tightened. Cut a length of wire to fit with slight end-shake between the triangular plate and "C" close by the pivot holes. Using this as a gauge for the distance between the shoulders of the  $\frac{1}{2}$ -in. silver-steel arbor, turn and polish pivots at each end, too tight for the holes, which are then broached to fit. Assemble the arbor in the plates to see that it is quite free, and with correct end-shake. This "end-shake" is a vague term, a matter of judgment and experience; but, as a rough guide, I would suggest about  $1/128$  in.

The 95- and 20-wheels on this arbor are again mounted on a common bush, the procedure being the same as just described. The distance between the shoulders is  $15/32$  in. Drill, bore and D-bit the hole, and part off about  $1/32$  in. proud of the 20-wheel, say  $9/32$  in. from the shoulder. The arbor is now to be reduced with emery-cloth as usual, to fit the bush tightly when the shoulder for the 95-wheel is  $\frac{1}{8}$  in. from the pivot shoulder. When pushed on to that distance, drill the large part of the bush for a tapered pin and fit it. The bush may then be taken off the arbor and another touch of emery cloth given to make it a "glove" fit. Push the wheels on the bush (and solder?).

It will give encouragement and enthusiasm if this arbor and the crank-shaft with their wheels are assembled in the framework and the depth of engagement is found perfect. If, on the other hand, it is a shade too deep or too shallow, the pivot hole in the triangular plate must be drawn with a round file in the required direction, broached to a diameter about  $\frac{1}{16}$  in. larger than originally, and a bush with a No. 40 hole hammered in and filed off flush. The amount that this will throw the arbor out of perpendicular with the plate is negligible.

The fly pinion (Fig. 16) comes next. Another gauge must be made as before for the distance apart of the pivot holes, a hole at one end to fit the end of the crankshaft, with a small hole, say No. 55, for the pinion pivot. Scribe a line on plate "B" from the approximate centre of the fourth arbor (for which a  $\frac{1}{2}$ -in. clearance hole was cut) in the direction of the crankshaft pivot-hole. Lay the gauge on the plate, with the crankshaft pinning one end in its bearing, and rotate it to get the No. 55 hole more or less on the scribed line. Cramp it, and drill the hole in "B." Fix the triangular plate on "B" by its three screws, but omitting its pillars, and produce the pinion pivot-hole from "B" into the triangular plate. Drill the 3-B.A. clearance holes in this plate for the pillars of the small bridge plate,  $1\frac{1}{8}$  in. apart. Make the small plate from  $\frac{1}{8}$ - or  $3/32$ -in. sheet-brass, cramp it on the triangular plate and produce the pivot hole and the two screw holes, the latter may then be countersunk on the inside of the triangular plate.

The pillars are  $\frac{1}{8}$  in. diameter,  $\frac{1}{2}$  in. long, drilled and tapped right through. See that the screws are not so long that their points meet. This little plate, being symmetrical, it is necessary



to mark it to ensure its being assembled always the same way; a neat method is to file a slight bevel all round the outside surface.

The fly (Fig. 16) is made of two bits of tin soldered on a sleeve of square section. Turn a scrap of brass-rod to 9/32 in. diameter for about 1/2 in. and reduce the snout to 7/32 in. for a good 1/4 in. Drill it with No. 30. Engage the dividing-head lever with the 60-wheel on the mandrel, having a chalk mark on every fifteenth tooth. File four flats until they just mark the snout, and go round a second time to make the corners sharp; the size of the marks on the snout will show you which sides of the square require a

further touch of the file. Cut off the snout and part off at 1/4 in.

The pinion leaves should not be longer than 3/16 in. Chuck it dead true, and reduce the shaft to fit fairly tightly in the brass square. Turn a pivot on each end, polished No. 0, and just too tight to enter the holes, which are then broached to fit. Clock flies are invariably mounted loose on their arbors and driven by a friction clutch to lessen the shock when suddenly stopped. Our fly revolves at such a moderate speed, that it can be safely pushed tight on the pinion-shaft.

(To be continued)

## Letters

### Fine Adjustment for Linkage

DEAR SIR,—Your contributor is in error.

The correct way is to consider the pitch of the respective screws. Thus, in his example, the

pitch of 40 T.P.I. =  $\frac{1.000}{40}$  in. = .025 in.,

likewise the pitch of 32 T.P.I. = .031 in. approximately. Thus, in one revolution the screw at one end moves .025 and the other balances it by a movement of .031, so that the distance between ends is altered .031 in. — .025 in. = .006 in. per revolution, which is very different from

$\frac{1}{1,280}$ .

I may point out that a finer adjustment may be obtained by using B.A. threads at one end and Whit. at the other. Thus, 1/4 in. = 40 with 4 B.A. gives .001 in. per revolution with 5 B.A. .0018 in. and with 6 B.A. .0041 in.

Yours faithfully,

JOHN H. REYNOLDS.

Bilton.

DEAR SIR,—I am afraid I must draw attention to a small, but rather important, error which crept into the article on "Fine Adjustment for Linkage," published in your issue for January 10th.

The author, in his example, takes a link having threads at each end of 32 and 40 T.P.I. respectively, and states that one revolution produces a relative movement of the pins of 1/40th of 1/32 in., i.e. 1/1,280 in. This is incorrect, since for one revolution one pin will move 1/40 in., whilst the other will move 1/32 in. in the same direction, thus producing a change in their relative positions of 1/32 — 1/40 in., i.e. 8/1,280 or 1/160 in. Thus the link has the same effect as a screw of 160 T.P.I. fixed at one end.

I might add that at the time I read this article I was considering various alternative means of producing a fine adjustment on the point rodding used on my 4 mm. scale layout, and this hint struck me as being the ideal solution. I propose to use an 8 B.A. and a 6 B.A. screw connected axially, the rodding being connected to appropriate sized nuts at each end. This arrangement would give a movement of 1/240 in. per turn. If this were too fine a 10 B.A. and 6 B.A. combination would give 1/107 in., in fact, almost any degree of adjustment is obtainable

by combinations of standard thread sizes.

Yours faithfully,

Wembley Park.

K. J. EASTON, A.M.I.E.E.

### Small Steam Turbines

DEAR SIR,—Replying to Mr. Harris's letter in the January 10th issue, I am grateful to him for his appreciative references to my article, but am sorry that he parts company with me. I hope we shall draw closer again after he has considered these arguments:—

Steam-engine efficiency cannot be judged on steam consumption alone. The adiabatic heat-drop (or energy value) of the steam must be taken equally with the steam consumption, e.g. for the purposes of the efficiency formula, 12 lb. steam with heat-drop of 300 B.T.U. per lb. (approximately that for the "White" engine quoted) is equal to 60 lb. steam with heat-drop of 60 B.T.U. per lb. The percentage efficiency formula is  $E = \frac{2,546 \times 100}{c \times h}$ , where 2,546 is

a constant, and  $c$  steam consumption per H.P. hour, and  $h$  the adiabatic heat-drop.

In the case of the "Doble" engine, the value of the re-heat in B.T.U. must be included in the heat-drop. It must be considerable, or the efficiency of the "Doble" engine might work out at over 100 per cent., which would be absurd. I calculate the efficiency of the "White" engine at approximately 78 per cent. Large "Parsons" turbines, with condensers, have exceeded 80 per cent., the value of condensing in B.T.U. being taken into account.

Re-heat is a principle which can be applied to small multiple-stage turbines. Is it not borrowed from the large turbine maker? It is doubtful whether the mechanical principles of the reciprocating engine will allow it much to exceed an efficiency of 80 per cent., if it has reached it. I admit that, at present, small turbines are less efficient than large ones, hence my desire to see improvement; but the gap to be bridged is nothing like the 8—1 which might be assumed from the letter under reply. May I suggest that, when all the advantages of the turbines are taken into consideration (not excluding the saving in lubricating oil), we may yet see Mr. Doble riding in a turbine-driven steam car!

Yours faithfully,

Newport, Mon.

J. H. JOHNSON.

# Clubs

## Society of Model and Experimental Engineers

The next meeting of the Society will be held on Saturday, February 16th, at 2.30 p.m., at 39, Victoria Street, Westminster, S.W.1., when Mr. H. H. Fenn will give a talk on Steam Generators.

There will be an informal Stationary Engine meeting on Saturday, February 23rd, at 2.30 p.m., at St. Peter's School, Great Windmill Street, Piccadilly Circus, W.1. The Society's boiler will be under steam and members are asked to bring models they wish to test out under steam.

Visitors to both these meetings are cordially welcomed.

Full particulars of the society may be obtained from the Secretary: J. J. PACEY, 69, Chandos Avenue, Whetstone, N.20.

## Merseyside Live Steamers

The third annual general meeting was held at the clubroom on January 22nd. The following were elected to office for 1946:—Chairman, Mr. J. P. Williams; Secretary, Mr. A. F. Duckitt; Treasurer: Mr. W. Partington; Auditors: Messrs. W. Lowther and A. F. Duckitt.

Attendance at meetings for some time past has been lower than formerly, due to a few members resigning. It is felt, however, that the band of enthusiasts which remains is the nucleus of a virile body, which will expand when the track is constructed. Work on the concrete components cannot be commenced until the weather improves. Meanwhile, the backroom boys are in a huddle—Please do not disturb! Meetings at the clubroom, 32, Ennismore Road, Fairfield, Liverpool, 7, on February 19th, and thereafter fortnightly, at 8.0 p.m. Those interested should communicate with the Hon. Sec.: A. F. DUCKITT, 145, Bowring Park Avenue, Liverpool, 16.

## Ulster Society of Model Engineers

The December meeting was voted one of the best we have had since the Society resumed its meetings in November, 1944. It took the form of a "get together" night, members bringing some very interesting models.

At the meeting held on January 21st, a sub-committee was appointed to go into the question of the building of a multi-gauge track. It was also unanimously decided by the members present to hold an exhibition early in 1947.

Our next meeting will be held on Monday, February 18th, 1946, in the Café Val-dor, Wellington Place, Belfast, at 7.45 p.m. Lecture by Mr. F. J. Rowbotham. The following meeting will be held at the same time and place on Monday, March 18th, 1946, when Mr. James Courtney, chief engineer, Northern Ireland Transport Board, will give a talk. A cordial invitation is extended to any prospective member to attend these meetings without obligation.

Hon. Secretary: E. C. MUNDAY, 10, Royal Avenue, Belfast.

## Glasgow Society of Model Engineers

The next meeting will be held within the Society Rooms, on Saturday, February 16th, 1946, at 7.30 p.m. The meeting will assume the form of a "power-boat conference," at which it is hoped to draft out the summer programme, assured by the revival of interest in the subject. Previous to the open conference, Messrs. R. H. Hannah and S. C. Todd will describe their interests, relating respectively to a special speed-boat, and a new design of flash boiler.

Secretary: JOHN W. SMITH, 785, Dumbarton Road, Glasgow, W.1.

## Cardiff and District Society of Model and Experimental Engineers

The annual general meeting, held in the Club Room at the Y.M.C.A. (opposite Queen Street Station), on January 16th, was well attended, despite the fact that it was a purely business affair, and keen interest was shown in the conducting of same.

Among many suggestions for improvements was one concerning assistance of a material nature to junior members, of which we have three or four now in the club, and more will be welcome if they care to attend our meetings at the above address on the first and third Wednesday in the month, or contact the Hon. Sec.: F. B. ANGWIN, 47, Rommilly Crescent, Cardiff.

## The Bristol Society of Model and Experimental Engineers

Our meeting on January 19th was pleasantly spent in discussing the very successful exhibition at the Bristol Museum and Art Gallery, the attendance at which exceeded 50,000 for the fortnight, and broke all records for the rooms.

The committee has been considering the advisability of a change in our meeting night, and the possibility of acquiring a locomotive track for the club. These matters were also talked over, but a decision was deferred until the opinions of all members could be obtained.

Hon. Sec.: C. C. LUCY, 28, Bibury Crescent, Henleaze, Bristol.

## Edinburgh Society of Model Engineers

Our next meeting will take place in the Society's rooms on Saturday, February 23rd, at 3.15 p.m., when our Hon. President, Mr. C. W. Sanderson, will read a paper on "North Eastern Locomotives," illustrated by lantern slides. Mr. Sanderson will also have his "Helen Long" locomotive on view.

Workshop and clubrooms at 1a, Ramsay Lane, off Lawnmarket, are open every Tuesday and Saturday, at 8 p.m. and 3 p.m. respectively.

Hon. Secretary: J. ROBERTSON, 41, James Street, Edinburgh, 7.

## NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Maidenhead, Berks.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Maidenhead, Berks.

# THE "MODEL ENGINEER" SALES AND WANTS

Private: Threepence word. Trade: Sixpence word. Use of Box 2/6 extra.  
Minimum charge, 3/-

## TOOLS & WORKSHOP

**Buck and Ryan's Department for** Lathes, Drilling Machines, Grinders, Electric Tools, Chucks, Surface Plates, Lathe Accessories and Tools.—310-312, Euston Road, London, N.W.1. Telephone: EUSTON 4661. Hours of Business: 8.30 to 5.0 p.m., Monday to Friday; Saturday, 1.0 p.m.

**For Consistent Quality**, friendly service and prompt deliveries—GARNERS, Sheffield Road, Barnsley. 'Phone 2866.

**Split Chucks** for watchmakers lathes, 6 mm., 6 1/2 mm., and 8 mm., 6s. each, Step Chucks, set of five, £2 17s. 6d. Draw in Spindles, 12s. 6d. each. Postage, extra 6d. Larger chucks made to order.—JOHN MORRIS (CLERKENWELL) LTD., 64, Clerkenwell Road, E.C.1.

**Taps, Dies, Reamers and Drills.** Largest stock in the North.—GARNERS, Sheffield Road, Barnsley. 'Phone 2866.

**Your Myford Specialists**, 100 per cent. replacements service.—GARNERS, Sheffield Road, Barnsley. 'Phone 2866.

**Corbett's (Lathes)**, Stanton Hill, Mansfield, offer Lathes; Lathe and Drill Chucks, Electric Motors, high speed and Wimmet tipped carbide lathe tools, 0-3/4" capacity five speed power bench drills, Wolf portable drills, treadle and electric grinders, vices, bench and machine, six hole leather punches. Copper tube, sheet, rounds, hexagons, silver solder, brazing blowlamps, etc. 1/3rd h.p. 230-250/1/50 B.T.H. Motors, price £6 10s., carriage extra, delivery guaranteed from stock. State requirements and include S.A.E. for lists.

**Drummond Hand Shaper**, automatic traverse forward and reverse, graduated turntable and vice, graduated swivelling tool post. In absolute showroom condition, hardly used. Best offer, secure, or exchange good small capstan. Buyer inspect and collect preferred. Mid-Sussex.—JOHNSON, "Linscotts", Warringlid, Haywards Heath, Sx. 'Phone evenings, Warringlid 214.

**We are Still at your Service**, Materials, etc.—J. R. MACHINE TOOL CO., 13, Beach Street, Deal.

**Adept Owners**, 0-4" Jacobs Pattern Drill Chucks, complete with arbor, 20s.; Tailstock Dieholders for 13/16" dies, sliding head type, 10s. 6d. each. "Adept" Spares and Accessories.—TERRY'S, Fishers Lane, Cold Ash, Newbury.

**Myford Accessories and Spares.** Burnerd, Pratt, and Crown Chucks. All forms taps and dies, etc., are offered ex stock. Send 2d. stamp for lists.—TERRY'S, Fishers Lane, Cold Ash, Newbury.

**Brass Angle** 1/2" x 1/16", 4d. ft.; Copper Tube prices per ft. 3/4" by 20 G., 1s. 3d.; 7/16" by 22 G., 8d.; 3/8" by 24 G., 7d.; thin walled 3/32", 1/8", 5/32", 3/16", 4 ft. lots, 1s. 9d. each size; Hard Brass Sheet, 6" wide 20 G., 24 G., 28 G., 1s. 9d., 1s. 5d., 1s. 2d. ft. Post extra.—EVERS-LEIGH, Trentham Road, Stoke-on-Trent.

**Workshop Clearance.** Engineers' equipment, cycles and parts.—RODGERS, 3, Clifford Street, Wolverhampton.

**For Sale, New**, 3 1/2" Myford Lathe, type ML4, with tumbler reverse on Stand, MA 102 for countershaft drive, 1 MA59 countershaft, 1 MA68 vertical slide, 1 MA75 3" S.C. chuck, 2 sets of jaws, 1 MA66 four tool turret, 1 MA101 thread dial indicator. This lathe is complete and new, still in maker's grease. Price £40. Buyer collect. Write —A. MARTIN, "Lock Cottage", Simpson Road, Blethley, Bucks., or 'Phone: Blethley 31.

## MODELS & FITTINGS

**Apex Minor** (Mr. Westbury's design) engine castings, also carburettor castings "M.E." June 14th issue. Delivery from stock. Also spiral timing gears. New Atom Minor 6 c.c. (Mr. Westbury's design). Patterns and castings in preparation. Orders booked in strict rotation. Trade enquiries invited.—THE HEADINGLEY MOTOR & ENGINEERING CO. LTD., 8, Otley Road, Leeds.

**Magic Midget Motors**, specially designed for economical running on cycle-lamp batteries. Ideal boat motor, 25s. each.—A. E. SIDWELL, North End, Leamington Spa.

**Majesco "45" Miniature Aero-Motor** (4.5 c.c.), die castings; all materials; detailed instructions; working drawings. Complete kit, 24s. (post paid).—MAJESCO MINIATURE MOTORS, 35, St. Flora's Road, Littlehampton, Sussex.

**Coils**, guaranteed "Featherweight," 1 1/2 oz. spark coils, list free.—THE MODEL STORES, 26-27-28, The Extension, Shepherds Bush Market, London, W.12.

**"Heilan Lassic"** We have a range of castings especially for this engine, made from the original drawings; also all frame and motion steel and all boiler materials. Catalogue for all "L.B.S.C." Locomotives. Price 6d. Please note that we are interested and supply parts for locomotives and their accessories only, from 2 1/2" to 7 1/2" gauge. £1,000 worth of castings actually in stock, also high grade boiler fittings, injectors, pressure gauges, etc. Boilers brazed up and boilers and components built to order at reasonable prices. We give service as well as sales.—DICK SIMMONDS, 41, Heathway, Northumberland Heath, Erith.

**3/16" Globe Valve**, 10s. 6d.; 3/16" Check Valve, 6s. 6d.; 3/16" Plain Water Gauge, 7s.—THOMAS McCracken, 388, Main Street, Rutherglen.

**Anyone Interested.** Two sets only, of Main Castings for 50 c.c. 4-cylinder petrol engine. See MODEL ENGINEER, page 68.—W. SAVAGE, 26, Springfield Road, Wallington, Surrey.

**David Curwen Experimental Engineers**, Gore Lane, Baydon, Nr. Marlborough, Wilts. Light power steam engines of all types.

**5" Gauge Tank Chassis**, 0.4-2, new, very well made, only requires coupling rods and trailing truck, including drawing and castings and sheet for chimney, dome, door and cab, etc. Ideal for small garden. No time to finish, £15, worth double.—"Loco," 80, Ridgeview Road, London, N.20.

**Building "Hielan Lassic?"** Materials from—MAXTEN, Central, Chatham Street, Ramsgate.

**"Cutty Sark"** by Dr. C. N. Longridge, Parts I and II wanted urgently. Please state condition and price.—HEADLAM, 44, Station Road, Winchmore Hill, London, N.21.

**Boiler Brazing and Building Service.** Boilers built or brazed to your own or "L.B.S.C." specification, tested and guaranteed. Personal attention to all orders. Send stamped addressed envelope for quotation against sketch or drawing, and list of Easyflow, Silbrailloy, etc.—CLARAUB, 6, Park Road, Wembley.

**Castings**, Pattern Making, Machining, Drilling, Boring, Boilers, Sheet Metal Work of all descriptions. Send your requirements.—KEVA ENGINEERS LTD., River Road, Creeksmouth, Barking, Essex.

## ELECTRICAL EQUIPMENT

**Electradix Bargains include:** Dynamo and Motor Generator Bargains. G.E.C. double current Dynamos, 6 volts, 5 amps., 600 volts, 80 m.a. ball-bearings, 17 lb., as new, 37s. 6d., carriage paid, 5s. refunded on returned packing case.—Below.

**Small D.C. Motor Generators** by leading makers for use in Radio Receivers to take the place of H.T. battery, 6 volts input, 10 volts, 15 m.a. output, or 12 volts input, 230 volts, 30 m.a. output, £3 15s., weight only 5 1/2 lb., size 5 1/2" x 3 1/2" x 3 1/2", model finish, ball-bearings, 2-comm., 2 separate windings, waterproofed.—Below.

**Transformers**, 3 K.W. Crypto, 230 volts to 115 volts, 28 amps., £9 10s., to small Bell Transformers, 230/3/58 volts, 7s. 6d. Transformers for Rewind, 3 K.W. with stampings 4 1/2" x 6" x 7 1/2", windings damaged by blitz, weight with damaged wire, 65 lb., 45s., carriage extra.—ELECTRADIX, 214, Queenstown Road, London, S.W.8.

**A.C. Motors**, 1/10 h.p. to 10 h.p., from stock; also D.C.—JOHNSON ENGINEERING, 88, Great Portland Street, London, W.1. Museum 6373.

**Brand New A.C. Motors**, 200 250 volts, high starting torque, 1/4 h.p., £5; 1/3 h.p., £5 10s. All sizes available.—JOHN STEEL, Bingley, Yorks.

**New Electric Motors**, 1 50, 1 40, 1 30, 1 20, 1 10 h.p., also 1/4 h.p., double ended and several 230 volt, single phase A.C.; low prices to clear.—ELECTRO-GENERATORS LIMITED, Australia Road, Slough.

## GENERAL

**Watchmakers Demobbed** need Lathes to start work again. John Morris (Clerkenwell) Ltd., will pay high prices for Lathes by Lorch, Boley, Wolf Jah, and American and Swiss makes.—64, Clerkenwell Road, E.C.1. CLE 6077.

**Watch and Clock Making.** If interested you can get all tools and parts, also wheels cut from—JOHN MORRIS, 64, Clerkenwell Road, E.C.1. Reprint no posts or lists, only counter service at present.

**Toys, Models and Novelties.** Book of designs with instructions. 50 illustrations. Popular number, 2s. 6d., post free.—HARROD (M), 10, Beaconsfield Road, Maidstone.

**Model Engineers.** No matter how small your problems, why not write to your Consultants. Tell us the Ship, Marine Engine, Locomotive, Track or Materials, and we will supply plans or advise where to purchase. Advice, 3s. 6d. Quotations free, S.A.E., by Practical Model Engineer. Est. 1919.—WILSON, MACDUFF & Co. LTD., 5, Victoria Street, London, S.W.1.

**Blueprints.** The best working drawings, locomotives, rolling stock, and permanent way, true to prototype. Send 2d. for list stating gauge.—HENRY GREENLEY, 66, Heston Road, Heston, Middlesex.

**"Model Engineer,"** 1907-1929, and "Wonderful Models," library bindings, mint condition, £1 a volume or offer.—ROGERS, Waverholme, Amersham Road, Little Chalfont, Bucks.

**Modeller's Scaled Rule**, brass, 12" long, engraved 7, 4, 3 1/2 and 2 mm. scales; indispensable to the model engineer, 2s. 6d., post free; "Cardboard Rolling Stock and How to Build It," 2s. 9d., post free.—E. RANKINE GRAY, 691, Christchurch Road, Boscombe, Hants.

**Best Quality Welding Set (B.O.C.).** Complete with cutting torch, hoses, nozzles, goggles, twin stage regulators, accessories, fluxes and books. Brand new, in original wrappings. Cost £25, accept £16. Wanted, Microscope.—Box No. 3891, MODEL ENGINEER Offices.

# Join the Well-Paid Ranks of the I.C.S. TRAINED MEN

What about your future? What of the new great world of to-day? There are marvellous opportunities, but only for those who have had specialised training. One thing is certain—there is not, and never will be, a worth-while place for the untrained.

*Ambitious men everywhere have succeeded through I.C.S. Home-Study Courses. So also can you. We offer you the benefit of our 54 years' matchless experience as creative pioneers of technical instruction by post.*

Write to the I.C.S. Advisory Dept. stating your requirements. Our advice is free.

*Here are some of the subjects in which we offer thoroughly sound instructions:*

ACCOUNTANCY  
ADVERTISING  
AERONAUTICAL ENG.  
AEROPLANE DESIGN  
AIRCRAFT ENG.

LICENCE  
ARCHITECTURE  
ARCH. DRAWING  
BOILERMAKING  
BOOK-KEEPING  
BUILDING  
BUILDING SPECIF.  
BUSINESS TRAINING  
CHEMISTRY, INORG.  
AND ORGANIC

CIVIL ENG.  
CLERK OF WORKS  
COMMERCIAL ART  
CONCRETE ENG.  
DIESEL ENGINES  
DRAUGHTSMANSHIP  
(State which branch)  
DRAWING OFFICE

PRAC.  
ELECTRICAL ENG.  
ELECTRIC POWER,  
LIGHTING, TRANS-  
MISSION, TRACTION  
ENGINEER-IN-CHARGE  
ENG. SHOP PRACTICE  
FIRE ENGINEERING  
FUEL TECHNOLOGY  
GARAGE M'G'MENT  
GAS-POWER ENG.  
HEATING & VENT.

HYDRAULIC ENG.  
JOURNALISM  
MACHINE DESIGNING  
MACHINE-TOOL W'K  
MARINE ENG.  
MECHANICAL ENG.  
MECH. DRAWING  
MINING ELECTRICAL  
MOTOR ENGINEERING  
MOTOR VEHICLE ELEC.  
MOULDING  
PLASTICS  
PLUMBING

QUANTITY SURVEY'G  
RADIO ENGINEERING  
RADIO SERVICE ENG.  
REFRIGERATION  
SALESMANSHIP  
SANITARY ENG.  
SCIENTIFIC M'G'MENT  
SECRETARIAL WORK  
SHEET-METAL WORK  
SHORT-STORY WR'T'G.  
STEAM ENGINEERING  
STRUCTURAL

STEELWORK  
SURVEYING (State which  
branch)  
TELEGRAPH ENG.  
TELEPHONE ENG.  
WATER-POWER ELEC.  
WELDING  
WOODWORKING  
WORKS ENGINEERING  
WORKS M'G'MENT

EXAMS. : E.J.B.C. Prelim., I.Mech.E., I.Fire.E., C. & G. Motor Vehicle, B.Inst. Radio Eng., P.M.G. Wireless Operators, B.O.T. Certificates, I.Elec.E., C. & G. Elec., R.I.B.A., London Matric. and many others.

*Special terms for members of H.M. Forces and discharged disabled members of H.M. Armed Forces.*

YOU MAY USE THIS COUPON

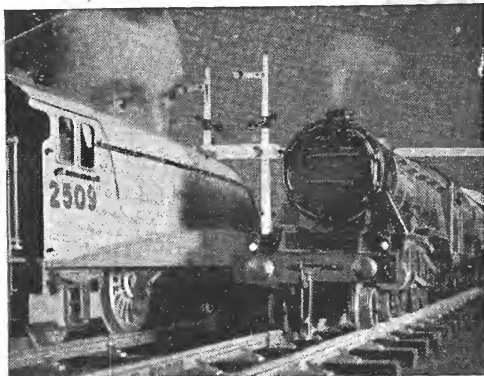
INTERNATIONAL  
CORRESPONDENCE SCHOOLS

Dept. 53, International Buildings, Kingsway, London, W.C.2.

Please send me particulars of your Courses in

Name..... Age.....  
Address .....

(Use penny stamp on unsealed envelope)



## MASTERPIECES in MINIATURE

WRITE FOR  
Wartime Stock List  
(L/16). Price 4d.  
"Building a 2½-in  
gauge Flying Scots-  
man." Price 1s.  
"How to Build a  
Traction Engine."  
Price 6d.  
"Laying Model Perma-  
nent Way." Price 3d.  
"Perfection in Minia-  
ture" (waterline  
models). Price 3d.  
The above are post  
free.

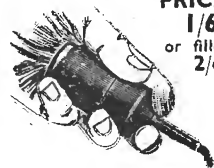
We are happy to announce that our famous hand-made scale models of trains, ships and engines, etc., will soon be in production and available to customers. We can supply castings and parts, materials and drawings for the model builder.

## BASSETT - LOWKE LTD. NORTHAMPTON.

LONDON : 112, High Holborn, W.C.1.  
MANCHESTER : 28, Corporation St., 4.

## THE FLUXITE GUN

is always ready to put Fluxite on the soldering job instantly.



PRICE  
1/6  
or filled  
2/6

## FLUXITE (SIMPLIFIES SOLDERING) PASTE

Is the most effective flux invented and has been used for over 30 years in Government works. It is also used for case hardening and for tempering steel. Ask for leaflets, also Free Book "The Art of Soft Soldering."

Of all Ironmongers, in tins, 8d., 1/4, 2/8

## FLUXITE POCKET BLOW LAMP, Price 2/6.

FLUXITE LTD., Dept. 79, Dragon Works,  
Bermondsey Street, S.E.1.